

# **East is Red**

**semi-generative audiovisual composition,  
composed instrument,**

part of the

**Audio Visual Live Composition System**

by

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## Abstract:

East is Red is a non-linear, semi-generative audiovisual composition. A composition which aims to be fluid, organic and chaotic, yet existing within a predefined universe of audiovisual media elements, and where the fundamental essence of the composition lies in a dynamic relationship between chaos and order. East is Red is in addition *a composed instrument*; a “playable” composition to be used for real-time audiovisual performance, characterized by the relationship between a semi-autonomous compositional system and an external human influence. This work, both as an exploration of generative and algorithmic audiovisual composition and as a composed instrument for performance, is part of a larger project infrastructure called Audio Visual Live Composition System. Individual works, such as East is Red, are manifested through the use of this customizable infrastructure. Audio Visual Live Composition System reflects areas of personal artistic interest and represents a structure to be used for future projects and research into non-linear audiovisual expressions. The underlying compositional principles of non-linearity, fluidity and responsiveness are present in any project manifested through the use of Audio Visual Live Composition System; ranging from individual compositions and performances to installations.

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## 1. Introduction

First and foremost this project represents an exploration and investigation of non-linear approaches to composition and art. For the last few years my work with musical composition and audiovisual expressions has shifted from the linear domain towards using systems which facilitate non-linearity. Not as a replacement of linear composition, but as an extension of the compositional and artistic repertoire. Non-linearity in artistic expressions has personally come to represent a new frontier, an area in which knowledge and methods from linear composition still apply, yet where the compositional form is fundamentally different. The development of this thesis is intended to serve as a way to increase understanding and to provide methodologies which can be practically implemented into my work. This thesis also seeks to place my work and research into a larger picture through the use of historical and contemporary examples, models and methodologies from various disciplines in order to create a proper contextual framework.

The conceptual and practical core of this project revolves around the development of a system used for non-linear audiovisual composition. The ideal characteristics of such a system is based on fluidity, chance, unpredictability, chaos and constant flux. However, this system is implemented with an intentional balance between chaos and order, and over the course of this thesis I will elaborate upon the motivation behind this choice. Furthermore, this thesis aims to define the nature of artistic works that exhibit varying degrees of autonomy and rely on systems in terms of execution and performance, and ultimately how, and in what form, this relates to the actual thesis production.

Exploration of real-time audiovisual performance, and the development of a compositional system with the characteristics of an expressive instrument, is one primary thesis objective. But can the thesis production still be defined as a composition if it involves the interactive characteristics of an instrument? This thesis process, alongside previous experiments and research, has led me to question the nature of works which can be considered performance instruments and at the same time be regarded as creative works, or compositions, in themselves. Should such works be regarded as instruments, compositions or something in between?

The aesthetic language of this work is audiovisual and aims to join the aural and visual domains into one unison expression. However, the emphasis on the audiovisual aspect in this thesis is not intended to be an in-depth analysis of audiovisual art-forms, but rather an investigation on how audiovisual expression can be implemented in a fluid, non-linear environment for composition and performance. This investigation will be based on observations made during the development process, and of how the audiovisual aspect affects the design of the system and ultimately how the audiovisual aspect is expressed in the end as a composition.

## 1.1 Background

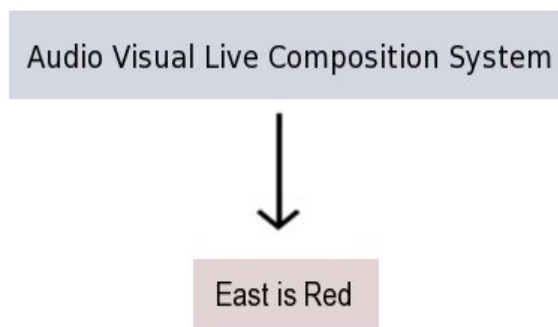
I have for as long as I can remember had a need for creative expression, and I have used various means to facilitate this need; from music, drawing and painting to making physical objects. These forms of self-expression increasingly matured with age into various forms of artistic expressions. From early adolescence I started becoming very interested in electronic music, and this interest gradually led to a home studio consisting of computers, samplers, synthesizers and drum machines. Those years had a tremendous impact on me and now I consider this period as part of my informal training in musical expression and composition; a period of self-education and a lot of experimentation, trial and error.

Music was the dominant interest for a long time, but I never stopped working with visual expressions either. There was always a sense that the aural and visual domains were individual and different domains, yet emanating from the same source and fulfilling each other.

My formal arts education first introduced me to working with moving images and eventually I started to study at the Academy of Fine Arts in Oslo. I was getting more acquainted with various electronic and digital media as well as starting to work more with sculptural objects and installations. The latter part of my BA studies saw an increasing interest in media art, electronic media and combinations of audiovisual expressions in spatial contexts. Furthermore, my work with electronic music and composition started becoming more and more important again, and although music was never really off my radar, it reemerged and my compositional approaches matured. Studying for a MA in New Media has been largely motivated by a wish to further develop skills to be used for media art projects, audiovisual expressions and exploring new aspects of musical expression and learning to apply new technologies and methodologies for composing.

## 1.2. Audio Visual Live Composition System (AVLCS)

The overlaying structure of this thesis is titled Audio Visual Live Composition System. It represents a technical and conceptual framework for audiovisual expression and non-linear composition; a way to express fluid and flexible audiovisual compositions in different output scenarios. “Live” has a double meaning: It reflects the generative aspect of this project by referring to a “living” composition, as well as referring to “live” in terms of being a tool for real-time performance. AVLCS represents a multi-purpose infrastructure which can be configured to operate autonomously as a generative audiovisual composition, it can be used as a *composed instrument* in performance settings and it can serve as a compositional engine used in the context of interactive installations. The concept behind AVLCS also allows for flexibility that can result in hybridizations of the aforementioned modes. Implementing all options above far exceeds the scope of this thesis and takes away the focus from the primary objectives; creation of a non-linear audiovisual composition and establishing the nature and characteristics of such a composition. The motivation and intent behind this thesis production is of an artistic kind, and the primary objective is to use this audiovisual infrastructure to create an independent work (see 1.3). However, it's necessary to view this independent work as one manifestation of several possible alternatives produced within the AVLCS framework. Viewing the thesis in the light of AVLCS helps defining the conceptual framework, as well as tracing the development process backwards to the early stages of the thesis and similar previous projects, as well as pointing forwards to future possibilities.



## 1.3 East is Red

East is Red represents the actual production part of this thesis and is an independent non-linear, semi-generative “playable” audiovisual composition produced using the AVLCS infrastructure. It's important to keep in mind when reading this thesis that East is Red and AVLCS are in fact inseparable: AVLCS represents the underlying infrastructure and East is Red is an independent work of audiovisual composition/composed instrument made and facilitated by the use of this infrastructure. AVLCS supports the larger context and conceptual framework of this thesis while East is Red represents the concrete artistic manifestation. East is Red is based on video footage and sounds collected during a 30-day field trip to China in the summer of 2006. The video material has previously been used for some movie projects and linear audiovisual compositions before ending up as raw material for East is Red. The footage is collected from the cities of Shanghai, Chengdu, Lhasa and Beijing.

## 1.4 Statement about East is Red

An epic and patriotic anthem called “*The East is Red*” was heard everywhere, in every city and village, during the Cultural Revolution in China. The tune was originally an old love song which got reworked in the 1940's to contain an association between Chairman Mao and the sun. “The East is Red, the Sun is Rising”. On April 24 1970 the first chinese satellite was successfully launched into orbit. The satellite carried a radio transmitter and “The East is Red” was broadcast to the world for 26 days from its orbit in the heavens.

China is more than a country; it's a phenomenon. China becomes the embodiment of the *exotic* when seen through Western eyes. A mysterious place which used to be closed to the outside world. Almost like another planet, seemingly incomprehensible at first glance. The Giant Red Planet exerts its gravitational force; its historical, economic, political and cultural influence ripples across the globe.

The point of view in this thesis work is that of a human satellite orbiting in and around Planet China. Observing, capturing and recording events, places and people, but always from a distance, separate and never really a part of the surroundings. Through these observations a composition is born, a personal account resembling an “audiovisual living memory.” Non-linear in nature, a different version with different details emerging whenever played or performed. The composition exists in a blurred landscape between objective documentation and subjective inner dialogue. A suggestive semi-narrative story of sounds and images emerges, as if mirroring the non-linear and sometimes chaotic environment of the human mind. Memories, thoughts and emotions all arise from the mind, linger for a while, before laying to rest and being replaced by the next thought, emotion or memory in a seemingly never ending stream. We only have partial conscious control over our inner processes and mostly they remain hidden, only revealed through dreams or when the veil of the subconscious is temporarily lifted. The semi-generative, non-linear, chance-based “inner nature” of East is Red can be regarded as a representation of the hidden aspects of our minds, whereas the performer actions and decisions influencing the *composed instrument* can be regarded as a representation of conscious control. This state is characterized by a balance between chaos and order. Out of this balanced union emerges a fluid and “living” audiovisual expression where China is the backdrop.

## 1.5 Brief Thesis Overview

The contextual framework of this thesis will be established in the first three chapters. This project is, not exclusively but to a large extent, founded on exploring approaches to non-linear composition as well as questioning the nature of compositional works which allow for interaction. Chapters 2 and 3 will be used to elaborate on issues which are central to the compositional aspects of this thesis project: Generative, systems-based and algorithmic approaches to art and composition. Many of the examples are from the world of music, however it's worth pointing out that these examples are not restricted to the aural aspects of this project, but are intended to be included in a larger *audiovisual* context. Examples from the field of audiovisual expression follow in chapter 4. Chapter 5 contains a full description of the thesis project production: Technical details, components, concepts, construction and features. The last chapters deals with future developments and final conclusions.

## 2 Generative Art

This thesis work encompasses the notion of generative art conceptually and practically. Most relevant are the underlying methods and processes of the system-engine of the non-linear audiovisual composition which methods are relying heavily on what is known as generative processes. This chapter on generative art takes a look at systems, and how systems play an important role as the “driving force” in this thesis work.

### 2.1 Definition

Generative art refers to a way of creating art; it is not a style of art or a subset of a style of art such as abstract art, digital art etc. It represents a method of art creation and is not connected to any particular art movement, motivation or ideology. The key aspect of the definition of generative art is the use of an autonomous system for art making. In other words, the artist gives partial or total control to a system to “generate” art.

*“Generative art refers to any art practice where the artist uses a system, such as a set of natural language rules, a computer program, a machine, or other procedural invention, which is set into motion with some degree of autonomy contributing to or resulting in a completed work of art.”<sup>1</sup>*

Philip Galanter

*“Generative art is a term given to work which stems from concentrating on the processes involved in producing an artwork, usually (although not strictly) automated by the use of a machine or computer, or by using mathematic or pragmatic instructions to define the rules by which such artworks are executed.”<sup>2</sup>*

Adrian Ward

Furthermore, generative art is not tied to any specific technology. It might be tempting to associate generative art with the use of computers, but as long as we emphasize the use of systems in the process of art making, the computer is one tool among various other systems. High tech is not a prerequisite for the label of generative art. However, for a work of art to be defined as generative it has to be well defined and self-contained enough to operate autonomously [1].

#### 2.1.1 Fields

Generative art is a method for art making characterized by the use of systems and is not tied to any specific ideology, movement or field. Generative art activity is present in various areas: Electronic music and algorithmic composition, computer graphics and animation, Live Cinema, audiovisual performance, VJ'ing and the Demo scene, industrial design, architecture and in fine arts.

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<sup>1</sup> Galanter, Philip. “What is Generative Art? Complexity Theory as a Context for Art Theory”, chapter 3.

<sup>2</sup> <http://www.generative.net/read/definitions>

### 2.1.2 Examples of Generative Art Methods

Randomization, chaos, L-systems, cellular automata, fractals, artificial life, artificial intelligence, Perlin noise, genetic systems and physical modeling.

## 2.2 Systems

After establishing that the defining aspect of generative art is the use of autonomous systems, it's time to investigate the notion of *systems* more closely.

### 2.2.1 Complexity Science and Information Theory

The understanding of generative art can be seen in the light of Information Theory<sup>3</sup> and Complexity Science<sup>4</sup>, which both represent scientific approaches to examining systems and providing an emerging abstract understanding of various systems and kinds of systems through study, comparison, mathematical and computational models.

### 2.2.2 Complex Systems and Complex Adaptive Systems

A complex system is a system where large numbers of small parts, or components, interact with similar nearby parts or components. In a complex system these local interactions lead to the system organizing itself without any overriding master control or controlling external agent. The system is self-organizing. It also represents a system which is characterized by constant dynamic change; always changing and not settling to a final stage void of change or development. These systems are known as complex adaptive systems if they react to change or influence in the environment.

The local components of complex systems interact non-linearly in a way that can be described like *the whole is greater than the sum of its parts*. Good examples of complex systems according to complexity science are the weather, stock market, the brain and the mind, predation and population cycles of animals in ecosystems, competition of genes and evolution and rise and falls of cultures and empires. These systems may seem random because they often develop dramatic, catastrophic or unpredictable results. The commonalities between these systems are:

*“Each of these systems consists of many components (such as cells, chromosomes, citizens etc.) that interact with other nearby components, and form a coherent pattern or entity without any central control or plan as how that should happen.”*<sup>5</sup>

Weather forms coherent patterns, such as a tornado, without there being a central control mechanism. The stock market is a similarly complex system in which countless user actions contribute, in a manner of cause and effect, to patterns of the overall system without there being a central plan or governing control mechanism. It generates surprises and unpredictable results regardless of knowledge of economy and economic mechanisms. Likewise, the weather can only be predicted relatively accurately for short time periods [2].

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<sup>3</sup> <http://encyclopedia.stateuniversity.com/pages/10580/information-theory.html>

<sup>4</sup> <http://www.ccs.org.il/Article.asp?cc=01020107>

<sup>5</sup> Galanter, Philip. “What is Generative Art? Complexity Theory as a Context for Art Theory”, chapter 4.



### 2.2.3 Chaotic Systems and Random Systems

Randomization is a well used and well known technique for generative art purposes. It's also a simple approach to generative processes since pseudo random number generators<sup>6</sup> are often embedded in many applications or found as objects in programming languages. Chaotic systems are often mistakenly seen as random because of the level of unpredictability, but there is a difference which is important to keep in mind.

Even if the underlying system of a complex system is following a deterministic logic based on sequential cause and effect, the overall behaviour of the system is very difficult to predict over time because the dynamics of such systems are non-linear. We can say that complex systems exhibit a chaotic behaviour. Because of the non-linearity aspect even small changes might “grow” unpredictably, making the system as a whole very difficult to predict over time. But even though chaotic systems might be hard to predict, they are fundamentally different from purely random systems.

Weather, again as an example, exists within borders, a territory, represented by minimum and maximum limitations. It might be unpredictable over time, but we know that weather takes place within a territory of possible weather states. This is known as phase space<sup>7</sup>:

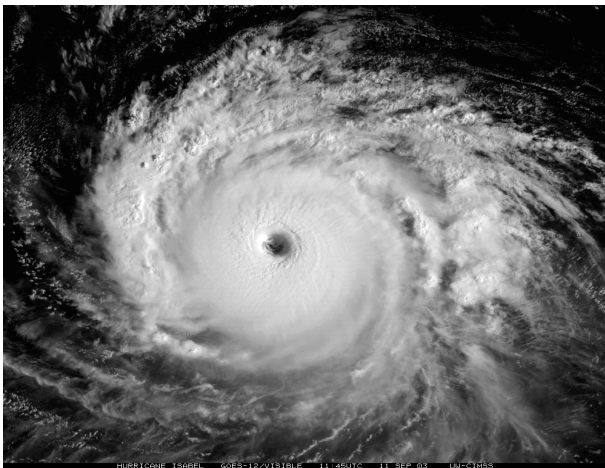


Figure 2-1: Hurricane “Isabel”.

A space in which all possible states of a system are represented. The chaotic system is unpredictable when considering small details, but general patterns can be traced when considering the system as a whole. Chaotic systems also display “a sense of history”, meaning that there is most likely a correlation when moving from one state to the next. A path within the state space. A likelihood that the next state of development resembles the former. On the contrary a purely random system has no such sense of history [3].

### 2.2.4 Order and Disorder

Information theory suggests that systems can be divided on an axis spanning from the highly ordered to the highly disordered, and that the complexity of a system can be understood by measuring how much information it carries. The capacity for carrying information is judged by how much “surprise” a given communication can exhibit. A highly ordered system, such as a single repeating symbol, is lacking informational value and exhibits no surprises. A highly disordered system, such as a string of random symbols, has maximum information value but lacks any structure or patterns. The overall complexity of a system is not found at any of the extremes; on the highly ordered and disordered ends of the axis, but rather in between [4].

<sup>6</sup> <http://www.nist.gov/dads/HTML/pseudorandomNumberGen.html>

<sup>7</sup> Galanter, Philip. “What is Generative Art? Complexity Theory as a Context for Art Theory”, chapter 5.

## 2.2.5 Effective Complexity

In practical terms one is most likely to find meaning in a signal if it's between extreme order and disorder, consisting of a mix between surprise and redundancy. Aesthetic experiences which are either extremely ordered or extremely disordered get very quickly uninteresting. Both extremes lack structural complexity.

Effective complexity means that structure and complexity increase in between the extremes of order and disorder. According to Murray Gell-Mann effective complexity is measured by giving highly ordered and disordered systems a low score indicating simplicity, whilst systems which are somewhere in between receive a higher score, indicating complexity. It's a way of measuring complexity that accounts for the difficulties encountered when considering that highly ordered systems are low in informational value and highly disordered systems are high in informational content, whilst none of them really have capacity for meaning nor surprise<sup>8</sup>.

Complexity science and information theory provides us with an understanding and a way to classify systems, from the highly ordered to the highly disordered, as well as providing a method to extract the effective complexity of any given system. Complexity science is very useful in gaining an understanding of what generative art really is since generative art is defined by the use of systems, as direct or indirect production method, and because systems can best be understood in the context of complexity science [5].

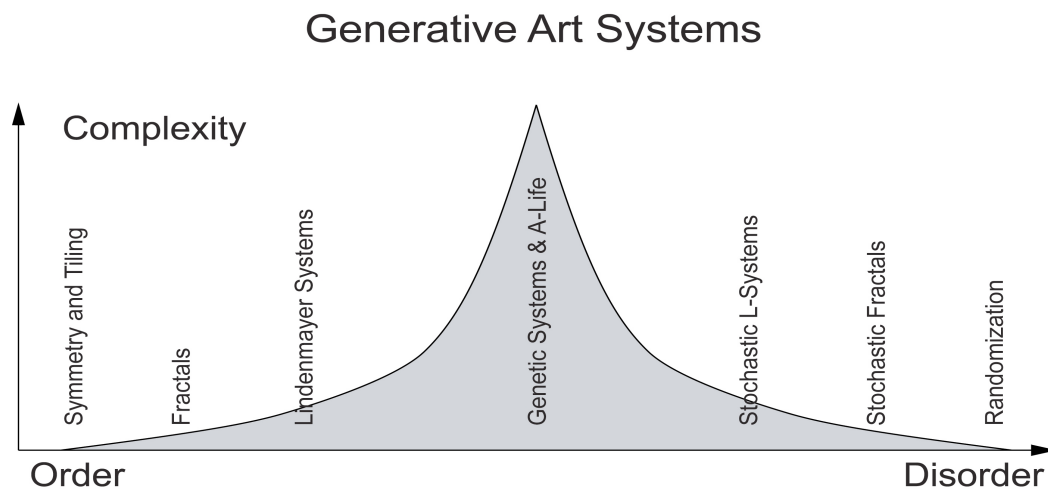


Figure 2-2: The relation between order, disorder and complexity in generative art.

## 2.3 Examples

Highly ordered generative art is as old as art itself argues Philip Galanter, pointing out that the use of for instance symmetry as a system in pattern making is one of the oldest known artistic methods. The use of symmetry, geometric patterns and repetition are all intricate parts of the human repertoire of visual expression dating back to ancient times. However, it's debatable whether the use of these methods should be considered autonomous systems or not, but the fact remains that artists throughout history have used “*systems of iterative symmetry and geometry to generate form*”<sup>9</sup>.

<sup>8</sup> Galanter, Philip. “What is Generative Art? Complexity Theory as a Context for Art Theory”, chapter 7

<sup>9</sup> Galanter, Philip. “What is Generative Art? Complexity Theory as a Context for Art Theory”, chapter 8.1

In the 20<sup>th</sup> century minimalists and conceptual artists turned to the use of geometric patterns, number sequences, combinatorial systems and other highly ordered systems in their artistic pursuits. One example being Sol Lewitt and his use of highly ordered systems to make combinatorial drawings and sculptures.

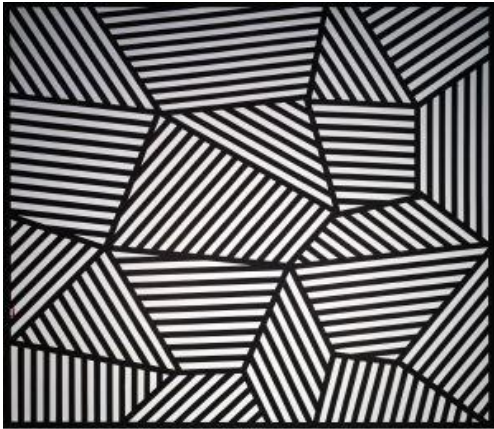


Figure 2-3: "The Flower", Sol Lewitt

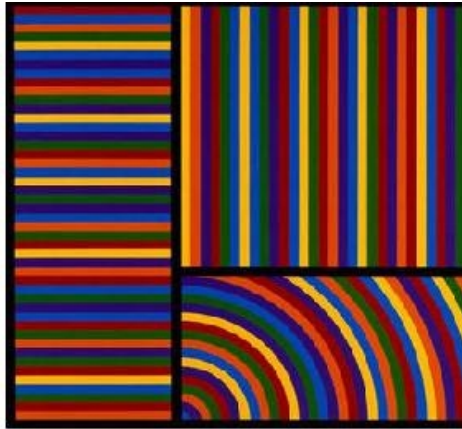


Figure 2-4: "Bands of Equal Width of Color 4", Sol Lewitt

Two good examples of artists using highly disordered systems to generate art can be found from the world of music: John Cage pioneered algorithmic and chance-based composition and was an advocate for the random selection of sound in music. Cage is famously known for the emphasis on the equal worth of all sounds. Wolfgang Amadeus Mozart is attributed for creating a dice game which relied on randomization; *Musikalisches Würfelspiel*. Both Cage and Mozart's Dice Game will be covered in greater detail later on in this thesis.

According to complexity science the level of complexity rises in systems which exhibit "surprise"; mixing order and disorder to achieve complexity.

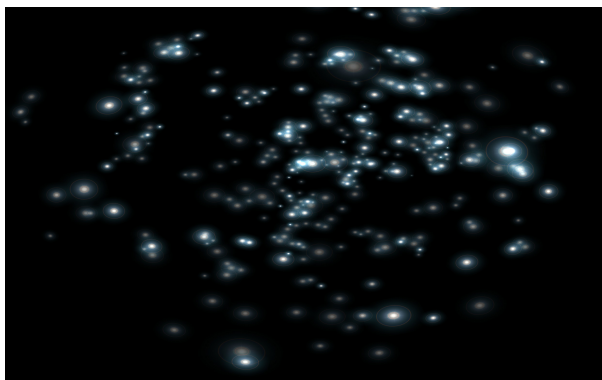


Figure 2-5: Black Shouls – stock market planetarium<sup>11</sup>.

Artists working with complex generative art work with many of the systems that are found when studying complexity science. These systems include: Genetic algorithms, swarming behaviour, parallel computational agents, neural networks, cellular automata, L-systems, chaos, dynamical mechanics, fractals, a-life, reaction-diffusion systems, emergent behaviour and other complex adaptive systems<sup>10</sup>.

Black Shouls by Lise Autogena and Joshua Portway displays a live representation of the world's stock markets. Artificial evolution used to create creatures interacting with a world of real time financial data.

<sup>10</sup> Galanter, Philip. "What is Generative Art? Complexity Theory as a Context for Art Theory", chapter 8.3

<sup>11</sup> <http://www.blackshoals.net/>

### 2.3.1 Marius Watz

Marius Watz describes generative art as a strategy for artistic practices, rather than a style or genre of work; a rule-based system operating external to the artist either produces works of art or is itself a work of art. He emphasizes that the aspect of generativity must be dominant in the work for the term generative art to have sufficient meaning and continues by saying that there are many art projects which have generative elements, but where the generative systems in themselves are not of a major concern.



Figure 2-6: "Illuminations B", Marius Watz (2007).  
Realtime projection, still images for print

Watz agrees with Philip Galanter that works which can be described as generative are found throughout art history, but personally he uses the term to describe computer-based works from the 1960's to today. To understand generative art, according to Watz, it's essential to consider much of the work in abstract painting and sculpture (Riley, Vasarely, LeWitt etc.) done in the 1960's [6].

### 2.3.2 Casey Reas

Casey Reas has been writing software which explores the idea of instability and plurality. The works are characterized by constant flux, never settling to a static state, and with perpetual change in relationships between the involved elements. The process itself is the key element of these works and continual exchange of information creates unexpected visual forms [7].

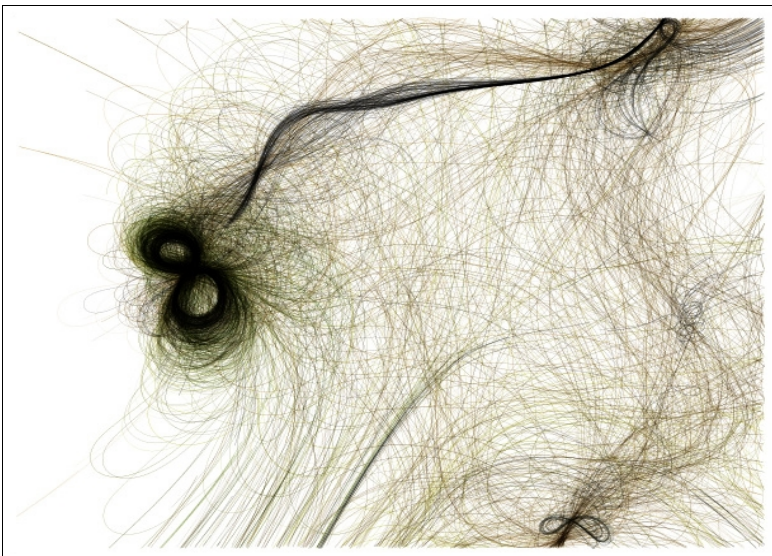


Figure 2-7: "Tissue Type A-00", Casey Reas (2002)



## 2.4 Generative Music

Generative music is the result of a composition generated by a system or process, and musicians, artists, producers and to some extent the composer, are absent from the creation process. After defining the parameters of the piece, a separation process occurs in which the composer separates himself from the creation of the final piece of music. The intention of generative music is to create a unique piece of music each time the system process is initiated. An important aspect of generative music is that the actual music heard will be different every time the system is reset and reinitiated, even though the characteristics of the music are similar [8].

### 2.4.1 Brian Eno

The term generative music was coined by Brian Eno as a way to describe music he created using a computer music software by SSEYO<sup>12</sup> called Koan. Brian Eno's interests in creating "self-generating and self-organizing systems" for generating music is an idea related to cybernetics [9].

*"I've always been lazy I guess. So I've always wanted to set things in motion that would produce far more than I had predicted." <sup>13</sup>*

Brian Eno

*"Since I have always preferred making plans to executing them, I have gravitated toward situations and systems that, once set into operation, could create music with little or no intervention on my part." <sup>14</sup>*

Brian Eno

Wind chimes can serve as examples of basic instruments for producing generative music. This basic form of generative music offers a very limited range of compositional control and the music produced will always reflect the original choice of notes. Computerized systems, such as the Koan Software, allows the composer to control 150 musical and sonic parameters. The computer then improvises within that range of parameters in a similar way as the wind improvises the wind chime.<sup>15</sup>

The wind chime itself represents the generative system, or process, and the person constructing and positioning the wind chime is the generative music composer. All the design solutions, such as choice of material, size and position of the bells, length and position of the metal rods and the final location of the wind chime, are affecting the audible result of the wind chime. The positioning of the wind chime is of importance since the wind may vary in strength depending on chosen location. After the generative system is created the "composer" steps aside and lets nature assert its influence.

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<sup>12</sup> <http://www.intermorphic.com/sseyo/>

<sup>13</sup> Brown, Paul. "Is the Future of Music Generative?" Music Therapy Today Vol VI April 2005. Referenced from: Eno, Brian (1996) "The Works I Have Made With KOAN Symbolise the Beginning of A New Era" The Independent, London 1 March p 10

<sup>14</sup> Seaman, William Curtis. "Recombinant Poetics: Emergent Meaning as Examined and Explored Within a Specific Virtual Environment". Referenced from: ENO, B. 1975. *Discreet Music*. Cover Notes. Los Angeles: Island Records.

<sup>15</sup> Eno, Brian. [http://www.intermorphic.com/tools/noatikl/generative\\_music.html](http://www.intermorphic.com/tools/noatikl/generative_music.html)

Music produced by the wind chime is chance-based, random, and occurs only within the same range of original notes, whereas the computerized systems offers a much greater range of variation [10]. Nevertheless, the generative principle in question remains similar whether it's a computerized system or a simple wind chime. Until the dawn of recording technology every musical event was unique and unrepeatable. The gramophone record made it possible to hear identical duplicates of music over and over again. Generative music has the qualities of live music; always different, and like recorded music generative music is free of time-and-place limitations; it can be heard when and where you want [11].

*"I really think it is possible that our grandchildren will look at us in wonder and say: 'you mean you used to listen to exactly the same thing over and over again?'"<sup>16</sup>*

Brian Eno

## 2.5 Wind Chime as a Model for AVLCS

Wind chimes as an idea, or model, can be used in the context of this thesis. The idea of the wind chime suggests setting up a *sound producing infrastructure*; designing a structure based on certain aesthetic criteria, selecting components which make sense (sound good) in unison. The design needs to be thought through since it's not only the sounds from single strikes that matter, it's all the possible combinations of strikes that matter. All the actions, all the sound possibilities of the wind chime, will take place within this predefined sound producing infrastructure.



Figure 2-8: Wind chime

The role of the wind is similar to that of a performer playing an instrument. It exerts external *influence* into the sound producing infrastructure, and the elements of the infrastructure are shuffled about in numerous ways based on the properties and the chaotic influence of the wind. The wind and the wind chime are in a symbiotic relationship, this symbiosis is what gives the wind chime meaning.

AVLCS/East is Red is an *audiovisual infrastructure* consisting of video clips in a database, visual effects presets, overlay/blending presets, control algorithms, audio and video analysis, sound banks and virtual instruments. All the components of the infrastructure are tied together by a system-engine, and fine tuned and tested over time to judge the suitability in a greater context as a composition. A wind chime is a generative instrument and likewise the compositions made using AVLCS are generated using an algorithmic system.

The AVLCS structure opens up for two modes in which external influence is used to interact with internal functions of the audiovisual infrastructure (Chapter 5.4). The external element is used to exert influence which activates, creates responses and causes changes internally in the audiovisual infrastructure in a similar way to the wind exerting influence and “playing” the wind chime.

## 2.6 Personal Perspective

It's not until the recent years that I have incorporated generative computerized systems into my works with sound, audiovisual works and in installations. However, the interest and fascination of applying systems in artistic projects, or using systems at some point as methods of production, goes back a long time. Generative methods were approached through intuition in the beginning, later on that intuition gradually led to a more conscious understanding of generative art activity, or work with systems- based art projects.

A keen interest in chance, randomization, chaos and coincidence started emerging through working with electronic music. *Art by accident* would be a good way of describing my attitude to these phenomena; mistakes in sequencing, programming and “misbehaving machines” could at times lead to some real interesting musical and sonic patterns. Finding interesting musical patterns and “hidden songs” created by chance and accidents turned out to be a real eye-opener. Gradually an interest in generative systems started emerging, and although my work in this period was based on linear musical composition, these discoveries can serve as an illustration of the beginning of an awareness of these phenomena in the context of music.

Not only in music did the intuitive interest in generative methods manifest; methods of chance, randomization, chaos and coincidence were similarly applied into visual artistic expressions. The awareness of chance-based principles became gradually evident here as well, especially when working with collages: In the beginning by paying attention to accidental alignments and juxtapositions of cut-out images and later on actively experimenting by shuffling cut-out images and using random fall-patterns as basis for visual compositions. Only later, after starting on my formal arts education, did I become aware that similar approaches were found in art history. It was rewarding to learn that there was a tradition behind these approaches that I had initially “figured out” intuitively, and it made it possible for me to see my own work and artistic development in a greater context.

### 2.6.1 Jean Arp



Jean (Hans) Arp, member of the Zurich Dadaists, developed a technique of cutout paper collages which were arranged based on random chance. Pieces of torn paper were dropped on the floor and Arp would subsequently arrange the pieces on a paper more or less the way they had fallen. This technique created a work free of human intervention and closer to nature. Chance operations represented a way of removing the artist's will from the creative act [12].

Figure 2-9: “Collage with Squares Arranged According to the Laws of Chance”, Jean Arp (ca. 1916-17)

## 2.6.2 Generative System in Thesis Production

As we have seen, generative approaches can be regarded as an artistic technique, and the term *generative art* covers a wide range of disciplines which have in common the use of autonomous or semi-autonomous systems at some point or throughout the process of creation. From the start of this project I have had an idea of how the characteristics of the audiovisual composition of the thesis production should be, or rather how the composition should *behave*. This idea is based on experiences from previous works and experiments and culminates into what could be described as an compositional “entity”.

A composition exhibiting behaviour, displaying organic qualities, unpredictability and surprises. In some cases (see 5.4) it reacts and responds to external influence which cause an effect in internal behaviour. The elements of chaos, randomization and chance play important roles in the design of the system-engine, yet this project as a whole is not about the exploration of generative systems as such, nor about complexity science for that matter. The work is not about *exploring systems for the sake of exploring systems*, but rather about exploring systems for artistic and compositional purposes. The artistic vision for this work overrides the system related concerns, nevertheless generative methods form an inseparable part of this project.

I would like to remind that AVLCS represents a customizable and adaptable structure. The autonomous and purely generative aspects of the thesis production are conceptually relevant parts of the design of the AVLCS infrastructure, although the independent work made in context of the thesis, *East is Red*, is a composed instrument and runs in a semi-generative configuration of AVLCS. Regardless of which AVLCS configuration is in question, the main idea is that there is an autonomous (or semi-autonomous) generative system ensuring some degree of chaos and unpredictability into an audiovisual compositional setting. However, the composition should exist within a certain area, within a given space. The audiovisual expression should unfold in an unpredictable, evolving and surprising way, yet it should happen in an contextual and aesthetic “space” defined by certain criteria I have put forth from an artistic point of view. In other words, a degree of order should function as a counterbalance to disorder. This is a fundamental principle of AVLCS and applies regardless of chosen configuration.

## 2.6.3 Example of Previous Work

A precursor to many of the elements explored in this thesis project can be found in an installation titled “Lineage” (2003). (APPENDIX A)



### 3. Algorithmic Composition

The term algorithmic composition implies a technique for composing music based on the use of algorithms. Algorithmic composition refers to *"the process of using some formal process to make music with minimal human intervention. This is often done on a computer, with the aid of formalisms, such as random number generation, rule-based systems, and various other algorithms."* [13]

Algorithm, according to the Merriam-Webster dictionary<sup>17</sup>:

*Algorithm: a procedure for solving a mathematical problem (as of finding the greatest common divisor) in a finite number of steps that frequently involves repetition of an operation ; broadly : a step-by-step procedure for solving a problem or accomplishing some end especially by a computer*

In terms of algorithmic composition the "problem" is to create music. An even better and more precise definition: *"a predetermined set of instructions for solving a specific problem in a limited number of steps."*<sup>18</sup>

#### 3.1 Serialism

Serialist composition was characterized by attempts to have complete control of all parameters of music and to objectify and abstract the compositional process as much as possible. Pre-composed series and matrices of values were used to control decisions over musical parameters such as notation, rhythm and dynamic markings, essentially "automating" the order of these parameters in a piece. The "algorithms" of series and matrices would override the human creative process so to speak [14].

#### 3.2 Computers

The advent of computers introduced incredible possibilities for algorithmic composition. Lejaren Hiller and Leonard Isaacson at the University of Illinois (1955-56) are credited for creating the first computer generated composition.



Figure 3-1: Hiller; Isaacson, "Illiac Suite"  
Quartet No. 4 for strings, 1957

They used the Illiac high-speed digital computer to program basic material and stylistic parameters which resulted in the Illiac Suite (1957) [15]. Hiller and Isaacson used the computer to simulate the compositional process itself. The score of the piece was composed on the computer and subsequently transposed into traditional musical notation and used in a string quartet [16].

<sup>17</sup> <http://www.merriam-webster.com/dictionary/algorithm>

<sup>18</sup> <http://ccrma.stanford.edu/~blackrse/algorithm.html>

### 3.3 Methodologies of Algorithmic Composition

#### 1) Stochastic composition:

Iannis Xenakis is regarded as one of the pioneers of computerized algorithmic composition. Xenakis created a program which produced data that he used for stochastic compositions and used computers to aid in the composition of scores for live ensembles, using statistical and probabilistic methods.

*"His 'stochastic music program' would 'deduce' a score from a list of note densities and probabilistic weights supplied by the programmer, leaving specific decisions to a random number generator ."* [17]

The term "stochastic" comes from mathematics and means *"involving a random variable"* or *"involving chance or probability."*<sup>19</sup> Atrées (1962) and Morsima-Amorsima (1962) were among the compositions created by Xenakis using computers and the stochastic methods. These scores were performed by live performers on traditional instruments.

The stochastic methods are regarded as the simplest forms of algorithmic composition, defined by the use of randomness, even though use of statistics and Markov chains<sup>20</sup> can add to the levels of complexity. Examples of stochastic methods can among others be found in the works of John Cage and Mozart's Dice Game. Both examples are covered later in this chapter.

#### 2) Rule-based:

Rule-based systems use a "grammar" which tells the compositional process of a way to behave once it has been initiated. Instead of using chance-based methods for compositional decisions, as was the case with stochastic methods, a rule-based system creates a language which the composition then subsequently will have to follow. Normally the program will run through a series of steps, one step leading to the next [18].

#### 3) Artificial intelligence (AI):

Artificial intelligence used for algorithmic composition works in a similar way to the rule-based systems (a pre-defined grammar for the composition has been put forth), but where the difference lies in the capacity of the system to learn. The AI systems doesn't just follow rules of a grammar, they define their own grammar. The composers using AI provide the system with a library of functions, subroutines, that directly affect the generated composition. This is done without defining how the functions will be used. The composer then takes the role of a critic, defining what type of output is desirable, and the computer tries to achieve that output by using the provided subroutines [19].

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<sup>19</sup> <http://www.merriam-webster.com/dictionary/stochastic>

<sup>20</sup> <http://mathworld.wolfram.com/MarkovChain.html>

### 3.4 Indeterminacy

The term indeterminacy means “having inexact limits”, “indefinite”, “indistinct”, “unsettled” and was mainly used in mathematics, physics, biology, linguistics, philosophy and jurisprudence. Indeterminacy didn't appear as part of the musical vocabulary until the late 1950's [20].

Indeterminacy as an approach to composition and performance:

*“....in essence it involves a shift of emphasis away from the idea of a musical composition as a sequence of fixed and fully realized elements to an approach seeking a significant degree of freedom and flexibility in both structure and notation.”*

This implies a major change in attitude and approach to musical composition:

*“....the liberation of music from the principle that every performance of a particular piece would be substantially the same.”<sup>21</sup>*

Through indeterminacy a greater level of spontaneity was encouraged. The performers, or the interpreters of an indeterminate piece, became “parts of the piece” by determining both the course and content of events [21].

#### 3.4.1 John Cage

One of the first to use the term indeterminacy in musical contexts was John Cage. Indeterminacy was for Cage a method of adding an entirely new dimension with regards to composition and performance. Other composers used indeterminacy, indeterminate techniques, but without fully detaching from the traditional concepts of composition. Cage was much more radical in his approach. He would question the validity of separating art as an activity from other areas of human life. In fact, Cage wanted to tear down the concept of creating art as something different from other human activities. As a result of this process the role and authority of the composer as the decision maker had to be challenged. Likewise would the concept of a traditional concert, with distinct separations of roles and expectations between composer, interpreter and listener, have to be challenged [22].



Figure 3-2: John Cage in performance, 1961

Cage's indeterminate works create a framework into which the performer is asked for responsibility, discipline and compositional decisions. “Concert for Piano and Orchestra” (1957/58) is a collection of ambiguous notation and no score whatsoever. Everything is left to the choices of the performer: Number of passages to be played, the order of the sections and the duration of the whole work. Immediately the notion of improvisation comes to mind, however that's not what Cage intended. In his opinion, improvising performers would eventually fall into patterns of likes and dislikes from their memories [23].

### 3.4.2 Use of Chance

John Cage is well-known for the use of chance operations in his works, chance became part of his compositional processes. Before using chance operations, for instance tossing a dice, the material to be used had to be defined and a system with rules had to be established for the chance operations to have any effect in a musical sense. In “Music for Changes” for piano (1961) Cage used chance operations to displace the responsibility for creative decision [24]. The random procedures of this piece was facilitated by using the *I Ching*<sup>22</sup>. Cage did however make a distinction between indeterminacy and chance operations:

*“Bringing about indeterminacy is bringing about a situation in which things would happen that are not under my control. Chance operations can guide me to a specific result, like the Music for Changes.”*<sup>23</sup>

John Cage

### 3.5 Aleatory and Aleatoric Composition

Aleatory is derived from the latin word *alea* and has many meanings such as dice, game of dice, risk, danger, bad surprise and chance. Most composers using this term would refer to chance, while others such as Henri Posseur, used it in the meaning of dice. Posseur composed a piece called “Repons pour sept musiciens” (1960) in which performers threw dice for sheets of music and cues. The procedure is reminiscent of W.A. Mozart's “Musikalisches Würfelspiel” (Dice Game), where the order of measures is determined by throwing dice. Although many composers used chance for creating compositions, allowing for greater flexibility of performance, there was still skepticism towards pure chance and mere accident. Instead controlled chance and limited aleatorism seemed more like a middle way, a compromise. This compromise bridges the gap between the concept of traditional musical composition and the radical indeterminacy as represented by John Cage [25].

French composer Pierre Boulez explored controlled chance by allowing performers a gradually controlled degree of choice in matters of rhythmic detail and structural sequence [26]. “Third Piano Sonata” (1955/57) is an example of a controlled chance composition. It was composed allowing for “automatisms”, or variability in serial structures, and limited liberties were introduced to the performance, including a flexible order of sound events and multiple combinations of certain structures. Boulez compared this sonata to a labyrinth: The performer can choose different paths to get through the piece [27]. Karl Heinz Stockhausen had a similar, but much less limited, approach in Klavierstück XI (1956). In this piece the performer is instructed to play sections in any sequence from a single page of nineteen discrete musical sections. The choices of the “route” are fully determined by the mood of the performer. There are however specific performance notes at the end of each sequence indicating *how* to play the next chosen section.<sup>24</sup>

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<sup>22</sup> <http://www.cfcl.com/ching/>

<sup>23</sup> Feisst, Sabine. “Losing Control: Indeterminacy and Improvisation in Music Since 1950”, 2002. Referenced from: D. Campana, “Interview with Cage (1985),” Form and Structure in the Music of John Cage, Ph.D. Northwestern University Evanston 1985, 109.

<sup>24</sup> Clark, Andrew. “Defining Adaptive Music”, 2007.

[http://www.gamasutra.com/features/20070417/clark\\_04.shtml#refs](http://www.gamasutra.com/features/20070417/clark_04.shtml#refs)

Referenced from: Morgan, Robert P. “Twentieth-Century Music: A History of Musical Style in Modern Europe and America”, 1991.

### 3.5.1 Thoughts About Aleatory:

The process of this thesis project and previous experience has to a large extent confirmed my own position regarding aleatory, indeterminacy and chance, and how and to what extent chance applies in my compositional works. It seems that *controlled chance* is the correct compositional approach from my personal aesthetic point of view. (At least when dealing with an audiovisual expression which relies on a somewhat narrative structure.)

Controlled chance, or the balance between disordered and ordered elements, resonates better with my own sense of aesthetics and intuition towards composition and art-making than, for instance, pure chance. The dynamic relationship between disorder and order, between chaos and structure, is what is appealing: It's a way of letting go, letting systems, processes and chance play a role, but not removing one's own presence completely from the process nor end-result. There is nothing stopping me from applying complete indeterminacy as an approach to composing, and who knows, in the future I might.

As a matter of fact the material used in East is Red has to some degree dictated the outcome, and I believe the compositional approach would have been quite different had the project material for instance been based on pure audiovisual abstractions.

The production done for this thesis and experience from previous works suggest however a clear preference towards controlled chance as method.

### 3.6 Musical Dice Game

Early examples of chance music are dice games. Musicians and composers in the late 1700's created dice games which allowed people to create different melodies by randomly putting together musical fragments from a list of choices. These systems allowed even amateurs to compose music without having to know the techniques or rules of composition. Many of these systems involved using dice or other forms of randomizers in order to select musical fragments from an array of choices. Johann Philipp Kirnberger (1721-1783) and Maximilian Stadler (1748-1833) were among the composers engaging in systems for generating music with the help of dice.

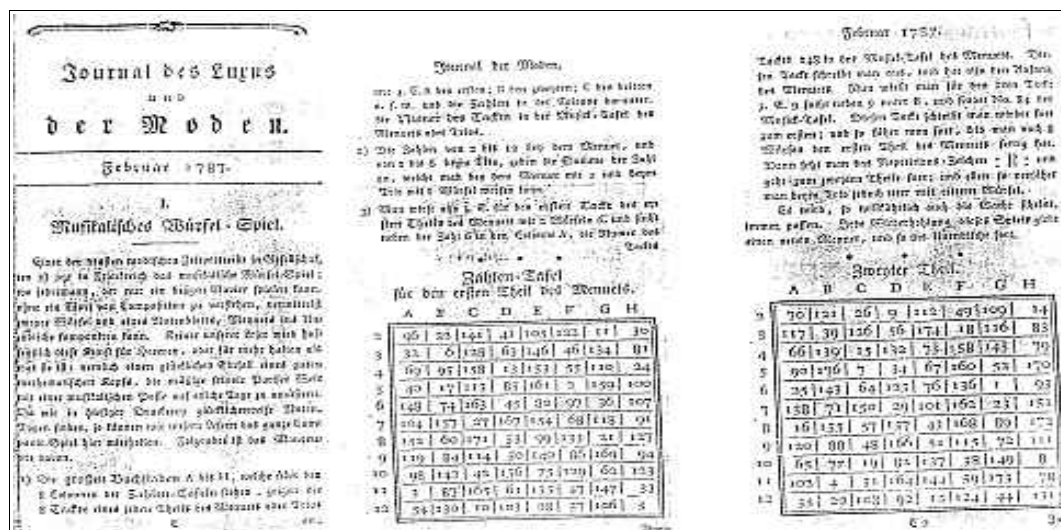


Figure 3-3: A dice game in a journal from 1787

Perhaps the most famous example is the *Musikalisches Würfelspiel* (Musical Dice Game). This dice game is often attributed to Wolfgang Amadeus Mozart, and it appeared one year after the composer's death. A 16-measure "waltz" was composed by rolling dice to decide which measures to select from an array of choices. The measures are numbered from 1 to 176, numbers arranged in two charts, each consisting of 11 rows and eight columns. The first measure was selected by rolling two dice and subtracting 1 from the total, and then the appropriate measure number could be determined by looking at the corresponding row in the first column of the first chart. This was then to be repeated with subsequent rolls of dice, deciding which measure to select from each successive column, in order to complete the melody. The number of possible waltzes generated from the system is staggering:  $11^{16}$  (or 45,949,729,863,572,161) possible waltzes. These are the possible outcomes in principle, but because many of the bars listed in the eighth column are identical, the actual number of different waltzes are actually less. Nevertheless, the amount of possible waltzes is anyhow enormous [28].

*"The number is so large that any waltz you generate with the dice and actually play is almost certainly a waltz never heard before. If you fail to preserve it, it will be a waltz that will probably never be heard again."* <sup>25</sup>

Martin Gardner

		ZAHLENTAFEL. TABLE de CHIFFRES.							
		A	B	C	D	E	F	G	H
Erster Theil.  Premiere Partie.	2	96	22	141	41	105	122	11	30
	3	32	6	128	63	146	46	134	81
	4	69	95	158	13	153	55	110	24
	5	40	17	113	85	161	2	159	100
	6	148	74	163	45	80	97	36	107
	7	104	157	27	167	154	68	118	91
	8	152	60	171	53	99	133	21	127
	9	119	84	114	50	140	86	169	94
	10	98	142	42	156	75	129	62	123
	11	3	87	165	61	135	47	147	33
	12	54	130	10	103	28	97	106	5

Figure 3-4: Dice game: table of numbers

### 3.6.1 Dice Game as a Generative System

Randomization, represented by the throw of dice, plays an important part of Wolfgang Amadeus Mozart's "Musikalisches Würfelspiel". The dice provides a chaotic, disorderly, element in the system. The pre-composed measures on the other hand represents order in the system. Mozart's Dice game is a very relevant and interesting example in the context of this thesis; it represents a system-structure which resonates with the aesthetic and artistic preferences of this thesis production. As already seen, Mozart's composition is divided between a an ordered aspect – the pre-composed measures, and a disordered aspect – the randomization represented by the dice. It seems like this work reflects Mozart's vast knowledge, understanding and musical competence: The random factor would prevent anyone, Mozart included, from predicting the composition because every time there will be a new random order defining the compositional structure in its entirety. Nevertheless, the pre-maid measures must have been written in such a way that any combination would "make sense" musically. Mozart had defined the ordered space in which the composition would take place, and the disorderly aspect, the chaos, would take place within the boundaries of that ordered space.

*"Perhaps Mozart knew intuitively that purely random music isn't terribly interesting because he found a primitive way to mix order and disorder. The short pre-composed measures provide order, and the throw of the dice provide disorder."* <sup>26</sup>

Philip Galanter

### 3.6.2 Dice Game as a Model

The Dice Game can serve as a model for AVLCS/East is Red and the underlying concept can be defined as following: Database + Algorithm = Composition. This equation can indeed be applied to a wide range of systems-based, generative, algorithmic and aleatoric works of many disciplines.

	Dice Game	AVLCS/East is Red
Database	176 measures	video banks + instruments sound banks + instrumens
Algorithm	roll of dice + chart	generative engine + (external influence)
Composition	16 measure waltz	audiovisual composition

Figure 3-5: Dice game compared to AVLCS/East is Red.

The thesis composition is structured to function, similar to Mozart's Dice Game, in an area between highly disordered and highly ordered influences. The disorderly elements are represented by the algorithms of the “Generative engine” (see 5.9 for more details). The orderly elements are represented by the content of the databases; video clips in the visual database and sound-banks of samples in the audio database. Additionally there are higher level functions in the system-engine which impose elements of order to the overall structure of the composition.

The major difference between AVLCS/East is Red and the Dice Game is the real-time aspect: In the Dice Game the algorithms are used prior to performance, while in AVLCS/East is Red the algorithms apply continuously, generating the composition in real-time. Furthermore, despite the obvious genius of Mozart's composing skills, and the musical understanding required to compose the measures and always keeping in mind the greater musical context into which the components will be assembled, the algorithm itself is of a very simple kind: All creative decisions are left to chance. The algorithms responsible for compositional development and character of AVLCS/East is Red include numerous influencing factors, some based on chance and others are not. Besides, this project operates with different modes (see 5.4), under different circumstances and with different goals. For instance the performance mode in which a performer interacts, exerts influence and actively “plays the composition”. The composition manifested through the use of the AVLCS infrastructure for the context of this thesis is indeed a “playable” composed instrument. But the generative processes governing the composition are still operational even in the performance mode, albeit to a lesser extent.



My intuitive approach to non-linear composing indicates a preference towards finding a balance between chaos and order in the compositional structure. Controlled chance seem to resonate better personally with regards to aesthetic and compositional concerns than relying solely on pure chance/random approaches. (However, this project does have a greater level of indeterminacy involved than some aleatoric approaches which allow only variation and interchangeability of parts and variations of details, but where the course of the piece remained determined. The course of this composition is not pre-determined.)

Elements of disorder works throughout the thesis project system, yet complete chaos is restricted by mechanisms which ensure order at the overall structure-level. There is a balanced relationship between order and disorder in the way this project has been structured, and this relationship is reflected throughout the whole system, on all levels of the system engine. Elements of disorder, such as chance mechanisms, are used as dynamical opposition to ordered elements within the system-structure.

### 3.7 Adaptive Music

Music composed and integrated in video games is often referred to as interactive music, but adaptive music is a more correct term since game music *“is supporting the dramatic action by adapting intuitively and discretely in order to remain contextually appropriate.”*<sup>27</sup> Game music can serve as good model when describing AVLCS: Music composed for games takes place in an audiovisual context, it's non-linear in nature and the sound-engine of a game is embedded into the overall system structure. AVLCS/East is Red is similarly an audiovisual expression, non-linear in nature and embedded into a system-engine structure.

Adaptive music in games is characterized by a system which continuously generates different versions (of the music). This can be likened to a live musical performance where there will be variations in the exact execution of a piece of written music. In fact these variations are to be expected. Nevertheless, a performed piece of composed linear music is intended to sound a certain way, even if there are variations in execution, because such a performance is an interpretation of a static linear ideal. Adaptive music on the other hand is consciously designed to sound different from performance to performance. The nature of adaptive music is flexible, and although individual expressions of a piece of adaptive music can differ from each other, each expression is still a representative of the composition at large.

Variations occurring in (a piece of) adaptive music are generated in response to a specified range of input parameters. This means first of all that the system is driven by external interaction (actions of user) and secondly that the nature of this external interaction is designed and planned. The actions of a user are events which happen within a specified range, and subsequently these events are responsible for variations in the musical performance. Furthermore, these specific events relating to the performance are characterized by a significant degree of indeterminacy (see 3.4). In other words, the timing, sequence, quantity, presence and values of input parameters are not predetermined.

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<sup>27</sup> Clark, Andrew. “Defining Adaptive Music”, 2007.  
[http://www.gamasutra.com/features/20070417/clark\\_01.shtml](http://www.gamasutra.com/features/20070417/clark_01.shtml)

The final form of a piece of adaptive music is expressed in performance time as a response to the indeterminate events (external interaction). However, adaptive music is essentially deterministic in nature because the music is always taking place within the range of specified events; if the exact same input parameters are used, the exact same output will be generated. Adaptive music is indeed not part of a tradition where randomness is an aesthetic goal.

Finally, a piece of adaptive music is intended to sound as if it was a linearly written piece of music. The goal is to make adaptive music work as a coherent piece of composition and according to aesthetic criteria set forth by the composer and within the musical tradition selected by the composer [29].

### 3.7.1 Micro-scoring

The term "micro-scoring" was coined by Troels Brun Folmann, composer of the game "Tomb Raider: Legend."<sup>28</sup> The methodology of micro-scoring is connected to adaptive music and is, according to Folmann; *"basically the idea of chopping your score down to very small components and triggering them in a way that compliments the game experience."*<sup>29</sup> This methodology was invented to counteract the tendency of repetitious and loop-like nature of game music. The score is broken down into small components and assembled in real-time as a result of user interaction [30].

## 3.8 Composed instrument

The term *composed instrument* can be described as a way to create an efficient and effective interface for performance that in addition of being a performance instrument is a creative work in itself [31]. Composed instruments can also be characterized by *"the sound producing part and the gestural performance part of the instrument are decoupled"* [32]. The musical instrument is a widely used metaphor to describe a wide range of artistic performances involving computers, and the term *composed instrument* describes systems used in musical (or other; i.e audiovisual) performances which not only carry the functions of instruments, but also determine various aspects of the musical (or audiovisual) work, for instance by resembling the notion of a score [33].

Composed instruments can be seen as an implementation of three categories used to define the nature of electronic instruments:

- 1) Musical instrument: Enables liberty for the performer to explore personal and original ways of playing.
- 2) Machine: Controlled by complex computational and algorithmic layers.
- 3) Representation: Integration of the two first categories. In terms of composing the representational nature represents a way to write scores, of defining events as well as defining underlying algorithms. In terms of performing, the representational nature represents adjustment of parameters and applying gestural control [34, 35].

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<sup>28</sup> <http://www1.tombraider.com/legend/>

<sup>29</sup> <http://createdigitalmusic.com/2006/10/11/cdm-interview-tomb-raider-legend-composer-troels-brun-folmann-on-adaptive-micro-scoring>

The determination of a musical work is the role of composing, while the execution of a musical work is the role of performing. The range of freedom for a performer (to execute a work) can span from executing a perfectly determined composition, to totally free improvisation. A similar metaphor can be used to illustrate the relationship between a performer and a composed instrument:

- A) Pushing a button triggering the execution of a pre-composed work. The music is entirely controlled by the computer system.
- B) Controlling every smallest detail of the performance. Everything is left to the actions of the performer (i.e using the hands).

Composed instruments are situated anywhere in the span between these two opposite extremes. The role of the performer can be defined accordingly using some metaphors: *Playing an instrument, conducting an orchestra or playing together (with a machine)*. The design, technique and intent of the computer system defines the role of the performer. For instance, if the performer is supposed to be *playing an instrument*, the computer system must be designed accordingly [36].

### 3.8.1 AVLCS as a Composed Instrument

The autonomous mode of AVLCS (see 5.4) can be compared to category **a)** of the previous section: Initiation and stopping are the only required external actions. This mode is generative and independent, and execution of the performance is handled by the system itself.

The configuration of AVLCS used for East Is Red can be likened to the metaphor of *playing together* (with a machine). The system-engine operates in a semi-generative manner in this configuration. Even without any external interaction the composition will still “play”, but in a more static way with reduced activity, less complexity and reduced compositional development. It's the actions of the performer controlling the macro-level compositional parameters and making performative decisions which ultimately bring “life” into the work. The configuration of AVLCS used for East Is Red balances between a playable instrument, controlled by performer actions, and an independent audiovisual composition governed by algorithms.

Note: It would be possible to design an AVLCS configuration in which all controllable parameters are left to the actions of the performer, comparable to the *playing an instrument* metaphor used earlier. However, that option is intentionally excluded from the project mainly because that would deflect considerably from the conceptual emphasis on algorithmic composition and generative principles.

## 4. Audiovisual Expressions

So far this thesis has been about defining the contextual framework in terms of generative, algorithmic and systems-based approaches to art-making and composition. The word *audiovisual* has been used many times when describing the nature of this work and I will now explain how that notion applies to the context of this thesis.

The fundamental idea is that projects manifested through the AVLCS infrastructure are to be considered audiovisual expressions. The essence of which is expressed through an equal and balanced relationship between the visual and the aural, transforming the visible and audible domains from two separate into one expressive domain. Furthermore, this audiovisual nature is expressed in a compositional form whether AVLCS is configured to operate autonomously, or in external influence configurations; as composed instruments.

The East is Red configuration of AVLCS used in the thesis context is, as already mentioned, that of a composed instrument. The point here is that all possible AVLCS configurations, and the subsequent artistic manifestations created, are to be considered of an audiovisual nature. This is a guiding principle and a referencing frame for the *language* of AVLCS facilitated works. In many ways this can be seen as a reflection on personal interests and background in which both the audible and visible domains are represented, and in a desire to develop a personal artistic language which highlights the aural and visual as one expression. The thinking behind this audiovisual approach goes back a relatively long time and has been expressed through linear works. The difference and the purpose of this thesis is to explore the audiovisual language in terms of composition in a non-linear, fluid and real-time based situation.

East is Red is the first work manifested using AVLCS and it also represents the first attempt of bringing the aural and visual domains together as one expression in a non-linear, semi-generative and interactive compositional environment. I think East is Red can defend the position of being an audiovisual composition regardless of the outcome, because the design of the system is fundamentally based on the integration of the aural and visual domains. And indeed the result of East is Red will always be based on audiovisual content. The open question is whether or not it succeeds in bridging the two domains into one coherent performable compositional expression, or if the work leans to either of the sides: Visuals with a complementary soundtrack or as a musical composition with accompanying moving imagery.

The compositional aspects, as well as the nature of works in between instruments and compositions, are the main underlying motivations of this thesis. These issues transcend the audiovisual aspect to some extent, but the audiovisual language as such is undeniably an important part of this work, and the thesis process has been a personal investigation of the audiovisual language (in a compositional context). The audiovisual issues will therefore be addressed when discussing the artistic outcome in the conclusive chapter.

## 4.1 Examples

These following examples are meant to provide a context in terms of audiovisual expressions. Some of the examples are closer to the thesis concept than others. The common denominator is the audiovisual aspect; the aural-to-visual relationship. This chapter is not meant to be an in-depth analysis of audiovisual expressions, but rather to provide an impression of the area of contemporary art practices which this project belongs to, and to use examples which highlight certain solutions related to the design of the system-structure as well as project organization.

### 4.2 Nodio by HC Gilje

The Nodio project by HC Gilje is a networked multichannel audiovisual system consisting of nodes which are sources for both video and audio and linked together by LAN or WLAN network. Nodio is a multi-purpose project intended for both installations and media performances and so far the Nodio project has resulted in two installations, "Dense" and "Drift", as well as in a performance by the Kretutzerkompani<sup>30</sup> called "Irre".

The basic project setup consists of 3 x computers, 3 x LCD monitors and 3 x speakers. The idea is that each node can operate individually or as a part of a bigger setup. The visuals can be moved freely between the nodes of the system and thus creating a sense of movement in physical space. The possible manipulations of the visuals can be done individually on each node or globally in the system.

The sound of Nodio operates in three different modes: **1)** Sound by image analysis, **2)** Amplitude selection of video clips, **3)** Each video clip refers to a certain frequency. There is also a simple sequencer included in the setup as well as parametric behaviours for movements, scaling and rotation which makes the setup "playable".

#### 4.2.1 Dense

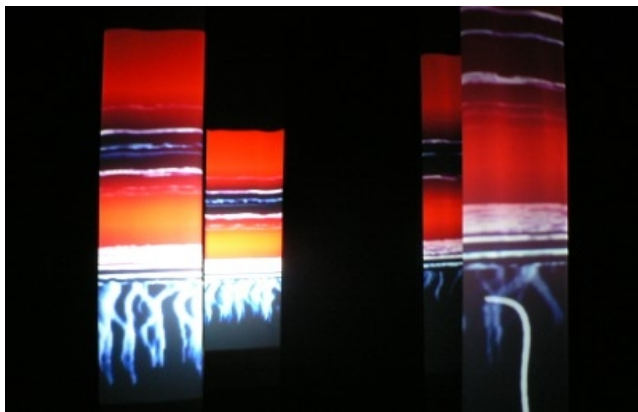


Figure 4-1: "Dense", HC Gilje, 2006.

Doublesided video projections on vertical semitransparent strips of material are used in this audiovisual installation. One projection creates a downward movement and the other projection creates sideways movement, and in combination both projections create an overlapping weave of visuals. The sound is generated by changes in the visuals.

*"Moving around in the space is like walking inside a videomixer, perception of image and sound changes dramatically as you move inside the installation."*<sup>31</sup>

HC Gilje

<sup>30</sup> <http://www.kretutzerkompani.com/index2.php>

<sup>31</sup> Dense: <http://www.bek.no/~hc/projects.htm>

#### 4.2.2 Drift



Figure 4-2: "Drift", HC Gilje, 2006.

Drift is a multichannel audiovisual installation. The nodes of the installation are networked and follow the same set of rules for behaviour, but each node makes individual choices based on a dice analogy. Processed images appear on each node and there is a correlation in which images "travel" from node to node over the network. In each node sound is generated from the video [37].

*"The overall result is an everchanging surrounding audiovisual landscape."* <sup>32</sup>

HC Gilje

#### 4.2.3 Relevance to Thesis

Nodio is a highly relevant project because it represents a multi-purpose audiovisual project infrastructure, and because of the nature of individual audiovisual works made using that infrastructure. The relation between Nodio as a system structure and an individual work, such as Dense, can be compared to the relationship between AVLCS and East is Red. Another relevant, and obvious, similarity is the audiovisual aspect. The Nodio system structure indicates a tight integration and correlation between audio and video. Moreover, the Nodio project clearly deals within an area of non-linear, real-time composition, which is closely related to the work of this thesis. The methods used are also related: For instance, the sounds are extracted by utilizing similar methods such as video analysis, and it also includes amplitude triggering (of visual parameters).

#### 4.3 Mycenae-Alpha by Iannis Xenakis

Mycenae-Alpha is an electroacoustic work composed by Iannis Xenakis in 1978 and was part of an installation consisting of lights, movement and music. It was the first work of electroacoustic music to be composed entirely on a tool for graphic composition called the UPIC system<sup>33</sup>. The UPIC system was developed in the late 1970's by Xenakis and his staff at the Center for Studies in Mathematical and Automated Music in Paris.

The UPIC system allows the user to generate all aspects of an electroacoustic composition graphically. These aspects can be divided into micro -and macro levels of the composition: The micro-composition refers to generating timbres by the creation of waveforms such as the standard types basic to electronic sound synthesis; sine, triangular and square waves, to more complex, quasi-random waves designed graphically by the user.

<sup>32</sup> Drift: <http://www.bek.no/~hc/projects.htm>

<sup>33</sup> <http://emfinstitute.emf.org/exhibits/upic.html>

The macro-composition refers to how sounds are organized in pitch and time, and takes place independently from the choice of waveforms. The result is a perceivable structure of the composition generated by a graphic score. Micro-composition takes place before the macro-composition because if no waveforms are selected the graphic score will be unable to produce any sounds. The graphic score resembles a conventional music score where the vertical axis represents pitch and the horizontal axis represents time measured in minutes and seconds [38].

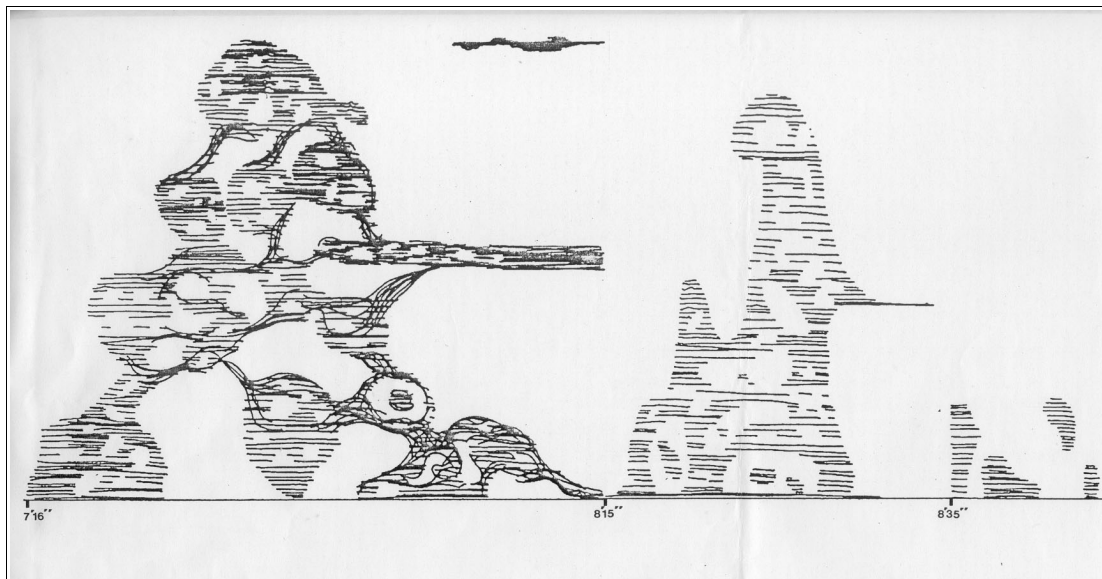


Figure 4-3: "Mycenae-Alpha", Iannis Xenakis. Part of the graphic score.

#### 4.3.1 Relevance to Thesis

The *image to sound* principle found in Mycenae-Alpha makes it relevant in the context of this thesis. The graphical score used in Mycenae-Alpha provides a visual component in the creation of the composition, a synaesthetic element which shows the correlation between graphical representation and waveforms, time and pitch. There is no graphical score present in this thesis work, however there is a method for detecting movement in video clips which is included and integrated as a part of the system-engine. The steady stream of various video clips, in either unaltered form or visually manipulated, provides the equivalent of a graphical score in the composition. Or rather, the image to sound principle is present and the visual information extracted is used as a way of generating sound.

The movement information is translated into two streams of numbers, one for the x-axis and one for the y-axis, and used (primarily) to control the pitch of instruments in the audio engine via MIDI (see Fig. 4-6). By translating visual information directly to a sound source a strong correlation between image and sound is produced. Furthermore, the visual data extracted is used to "feed" the system-engine with a relevant stream of data which can be mapped to different features inside the engine, and used as a driving force in the generative-engine (see 5.9).

Visual information is used in this thesis work as a direct source for generating sound on the micro level, and as a source for compositional events to take place on the macro level. Extracted visual information serves additionally as a means to provide data used at various points throughout the system engine, to drive system specific processes, and thus provide contributions to the *internal behaviour* (see 5.5) of the composition at large. The internal behaviour is in essence based on an internal feedback system in which streams of information are routed and mapped in between multiple parameters inside the system engine. The visual information extracted from the video output is one of the contributing factors to this internal feedback.



Figure 4-4: Two motion detection instances with two data streams each (x-axis, y-axis).

- Motion detection 1: x = panning, y = pitch (sent to instrument 1)
- Motion detection 2: x = resonance, y = portamento (sent to instrument 2)



#### 4.4 Piano - as image media by Toshio Iwai

Piano - as image media (1995) by Japanese artist Toshio Iwai is an interactive audiovisual installation. The keys of a piano are triggered by the use of a virtual score which in turn induce a projection of computer generated images on a screen. Viewer-participants use a trackball and position dots on a moving grid projected in front of the piano. The melodies, as well as the visuals they produce, are generated through the pattern of dots assembled by the users. The piano is activated when the patterns of light reach the keyboard making it possible to create tonal structures even without knowing how to play a piano. Three-dimensional abstract patterns are projected onto a vertical screen as interpretations of the tonal picture.

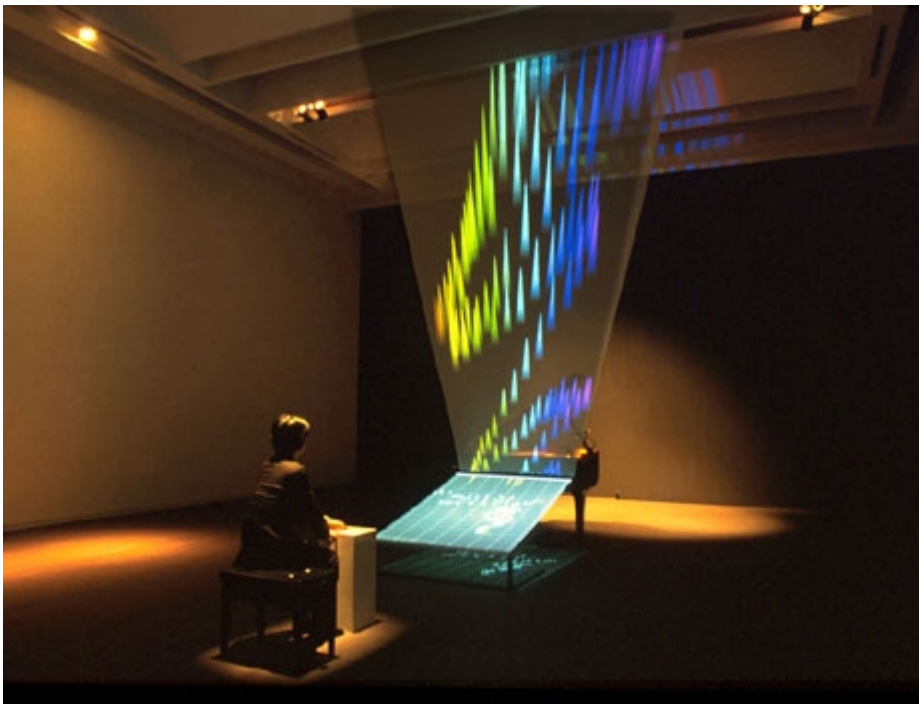


Figure 4-5: "Piano - as image media", Toshio Iwai

Iwai's project produces an audiovisual experience with a clear correlation between sound and image; the attention is removed from the single elements and shifted towards a synaesthetic sensory experience. "Piano - as image media" creates a connection between the virtual and the mechanical, and it emphasizes connections between notation, sound and visuals. The title suggests that the piano as a physical object manifests itself as "image media"; controlled by and controlling different media elements. Iwai's work highlights the characteristics of the digital medium; the fluidity and translatability of diverse media elements, and removes the focus on the single elements of sensory experience on behalf of a larger synaesthetic experience [39,40].

## 4.5 Audiovisual Environment Suite by Golan Levin

**Audiovisual Environment Suite** (AVES) from 1998-2000 is an interactive software for real-time creation and manipulation of simultaneous visuals and sound. AVES consists of five interactive systems for real time creation and performance of abstract animation and synthetic sound.

*"Each environment is an experimental attempt to design an interface which is supple and easy to learn, yet can also yield interesting, infinitely variable and personally expressive performances in both the visual and aural domains. Ideally, these systems permit their interactants to engage in a flow state of pure experience."*<sup>34</sup>

Golan Levin

A controllable dynamic audiovisual "substance" is the metaphor which the AVES system is built around. Each instrument of the AVES system draws from the visual language of abstract painting and animation and uses low-level synthesis techniques which permit tight integration of sound and image. The AVES system connects art, design and the engineering of tools and instruments [41].

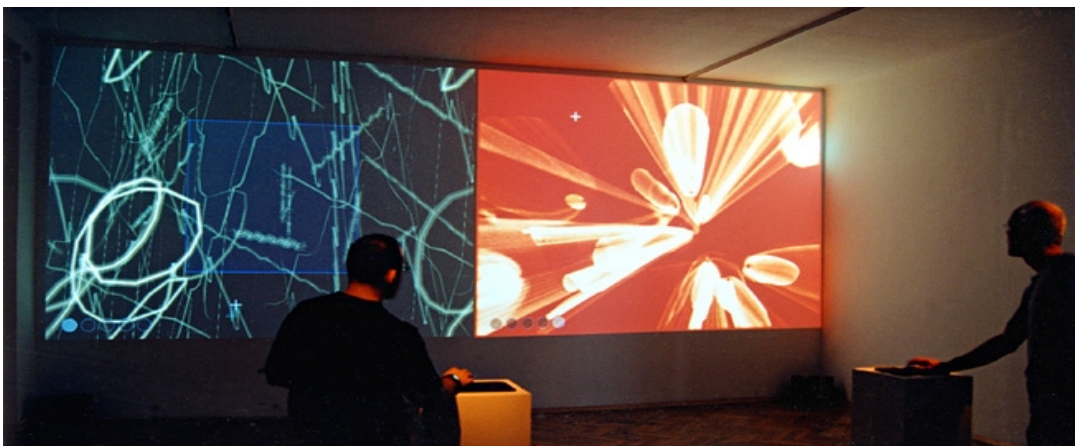


Figure 4-6: "Audiovisual Environment Suite", Golan Levin.

### 4.5.1 Scribble

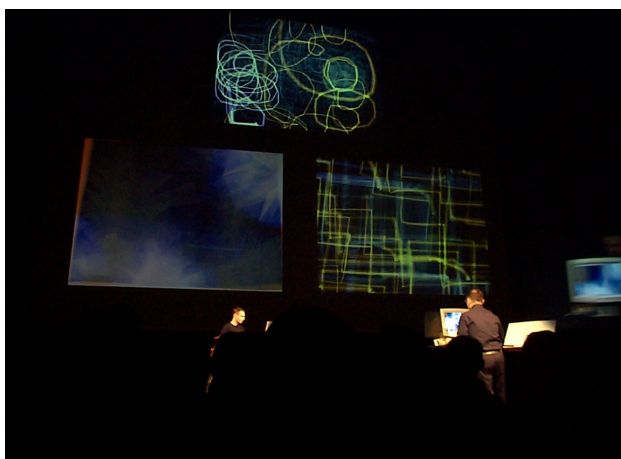


Figure 4-7: "Scribble", Golan Levin.

Scribble was a live color-music performance composed and performed by Golan Levin, Scott Gibbons and Gregory Shakar, commissioned by the Ars Electronica Festival in 2000. Scribble was performed using AVES [42].

<sup>34</sup> <http://acg.media.mit.edu/people/golan/aves/>

## 4.6 Messa di Voce

Audiovisual performance by Golan Levin, Zachary Lieberman and with Jaap Blonk and Joan La Barbera (2003). This performance, and installation, is a further continuation of Levin's work on synaesthetic relationships between sound and image. Speech, shouts and songs by two abstract vocalists (Blonk and La Barbera) are augmented in real-time by custom interactive visualization software. *Messa di Voce* was manifested as a performance as well as an installation. The software interprets sound and transforms every vocal nuance into complex, highly expressive and playful graphics. The spontaneity and unpredictability of human improvisation is fused with computer vision and speech analysis technologies, producing a synaesthetic experience in an immersive environment situated in the intersection of human expression and technological performance. Thematically *Messa di Voce* touches upon abstract communication, synaesthetic relationships, cartoon language, and writing and scoring systems [43].

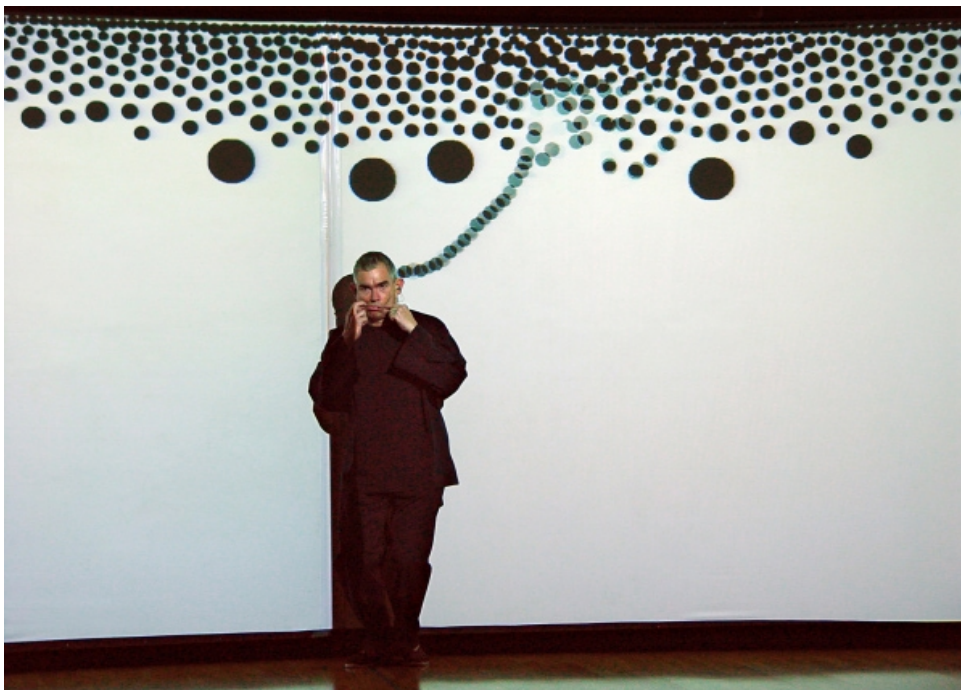


Figure 4-8: “Messa di Voce”, Golan Levin and Zachary Lieberman. Here with vocalist Jaap Blonk in action.

## 5. Audio Visual Live Composition System / East is Red

### 5.1 Introduction

This chapter describes the thesis production by clarifying concepts and explaining how the system structure is planned and implemented, not only as a technical construct, but in the greater context, as a compositional engine. Some of the information presented will elaborate on aspects which are general features of the underlying AVLCS project infrastructure, such as *modes of operation* (5.4) and *behaviour* (5.5). The segments on the system, video, audio and generative engines (5.6 to 5.9) apply specifically to East is Red. These engines are specially configured for East is Red, although any audiovisual composition/artwork based on AVLCS will have a somewhat similar system structure.

### 5.2 Graphical Programming Environments

Graphical programming environment, or visual programming environment, is the definition of software allowing for visual expressions in the process of programming<sup>35</sup>. In other words, it allows users to manipulate programs graphically instead of textually.

There are many types of graphical programming environments and they are popular tools for creative and artistic expressions. Such programming environments are highly flexible, open up possibilities for customization and are based on real-time computation. They offer a different and more intuitive approach to programming than textual programming. Of course, that's a subjective and generalized statement: People who are fluent in textual programming might feel it's the other way around. However, in my view these environments open up the power of programming to people who are not necessarily inclined towards textual programming. At least this is true in my own case. Music and musical performance, audiovisual works and interactive installations are often manifested through the aid of graphical programming environments. Here are a some examples of commonly used graphical programming environments:

- Max/MSP<sup>36</sup>
- Pure Data<sup>37</sup>
- Apple's Quartz Composer<sup>38</sup>
- EyesWeb<sup>39</sup>

#### 5.2.1 Patching

Graphical programming environments are often referred to as “patchers” because various functions and objects are “patched” together, which is another way of saying that the functions and objects are *linked* together in the actual graphical environment. A *patch* is a base processing unit similar to a *routine* in traditional programming languages according to the definition of a patch in Apple's graphical programming environment Quartz Composer<sup>40</sup>. A patch executes and produces a result, but unlike traditional routines, a patch is a visual entity that can be added to the graphical programming environment.

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35 <http://encyclopedia2.thefreedictionary.com/visual+programming+environment>

36 <http://www.cycling74.com/>

37 <http://puredata.info/>

38 <http://developer.apple.com/graphicsimaging/quartz/quartzcomposer.html>

39 <http://musart.dist.unige.it/EywMain.html>

40 [http://developer.apple.com/documentation/GraphicsImaging/Conceptual/QuartzComposerUserGuide/qc\\_concepts/chapter\\_2\\_section\\_3.html#//apple\\_ref/doc/uid/TP40005381-CH212-DontLinkElementID\\_2](http://developer.apple.com/documentation/GraphicsImaging/Conceptual/QuartzComposerUserGuide/qc_concepts/chapter_2_section_3.html#//apple_ref/doc/uid/TP40005381-CH212-DontLinkElementID_2)

## 5.2.2 Max

The first graphical compiler was called Max and written by Miller Puckette in 1988. At that time computers were not fast enough to deal with sound so Max was designed to only deal with control signals used for musical synthesis. Later as computers became faster and were able to compute soundwave samples in real-time, the appendix MSP was added to the Max structure (Max/MSP). A computer was now turned into a complete musical instrument, and laptops became increasingly used for live musical performance. Max/MSP was developed by Puckette and Zicarelli at IRCAM in Paris in the period 1993-1994. An extension to video synthesis called JITTER was added and subsequently the whole package was turned into a commercial product by Zicarelli and named Max/MSP/JITTER. Puckette became a professor at UCSD and wrote an open source program called Pd (pure Data) which was a close equivalent to Max/MSP. Since the release of Pd many extensions have been added and most notably is GEM which allows for video synthesis on the Pd platform [44].

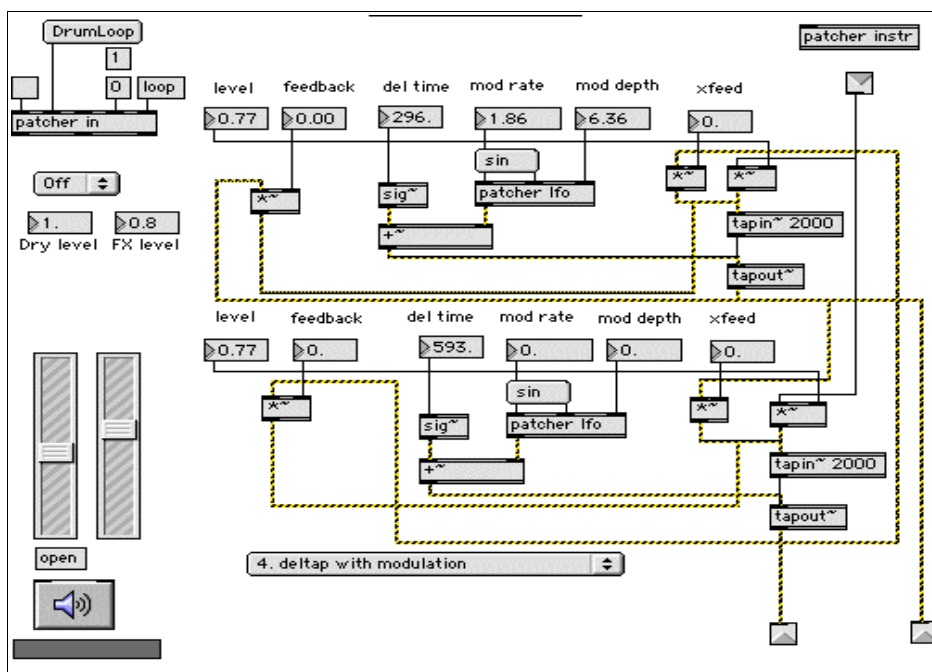


Figure 5-1: Example of a Max/MSP patch

## 5.2.3 Pure Data

Pd, or Pure Data, is a real-time graphical programming environment for audio, video and graphical processing. As mentioned Pd is a branch of the family of patcher programming environments known as Max. The core of Pd is written and maintained by Puckette but Pd includes the work of many developers. Pd is an implementation environment and not a specification language. The documents in Pd are called patches. Pd can be extended by writing classes called "externals" or patches called "abstractions" [45].

*"Pd was created to explore ideas of how to further refine the Max paradigm with the core ideas of allowing data to be treated in a more open-ended way and opening it up to applications outside of audio and MIDI, such as graphics and video."* <sup>41</sup>



## 5.2.4 Background with PD and Graphical Programming Environments

My knowledge of graphical programming environments started by attending a sound workshop based on Max/MSP. The learning curve was rather steep since I don't see myself as being naturally inclined towards programming in the first place, and it took time before being comfortable and skilled enough to utilize graphical programming environments effectively. Later I was introduced to Pure Data through involvement in artistic projects (networked installations). Programming was not my role in any of these projects, but the involvement served as an indirect introduction to PD and in many ways opened up my eyes for the possibilities that this program offered. A few years later I started on the MA program in New Media, attended a PD-based workshop on sound and gradually began using PD more and more also for own projects and experiments. Slowly I overcame the technical barrier and started becoming comfortable enough in this environment so that ideas could be realized with increasing ease.

According to my experience there is a certain threshold to overcome before being able to utilize this programming environment effectively. I believe one needs to be fluent enough with the basic operations before being really able to realize more sophisticated ideas in a satisfactory manner. That basic knowledge can be used to go even further and solving more advanced problems along the way. Indeed this applies for any programming language, and in an even broader sense, any skill or acquired technique. In 2006-7 I started using PD, as well as Max/MSP/Jitter, in non-linear musical compositions and in interactive real-time audiovisual works (APPENDIX B and C). I continued by using PD as a tool for generative, non-linear sound composition experiments in the period leading up to the start of my thesis. Subsequently PD was chosen as a platform for the development of what would become the foundation for the system engine of this thesis work.

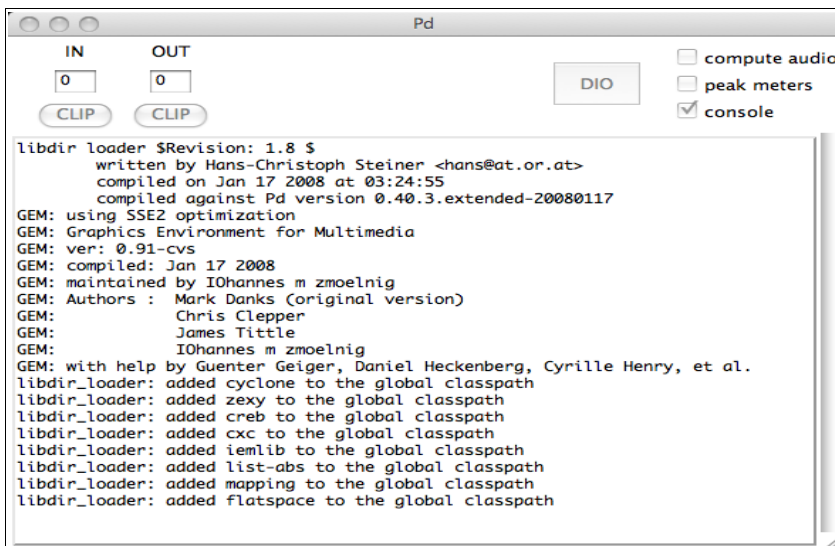


Figure 5-2: Pure Data console.

### 5.2.5 The Role of Pd in East is Red

The flexibility of working in such environments is what draws me to use PD for artistic projects. It's a great environment for experimentation, and one of the aspects I value the most is the possibility for customizing own personal tools for artistic expression. Besides, PD can be integrated with other softwares, with external hardware, with sensors and the very flexible nature of the graphical programming environment in itself, makes it an ideal platform for creative freedom and the limitations seem few and possibilities seemingly endless.

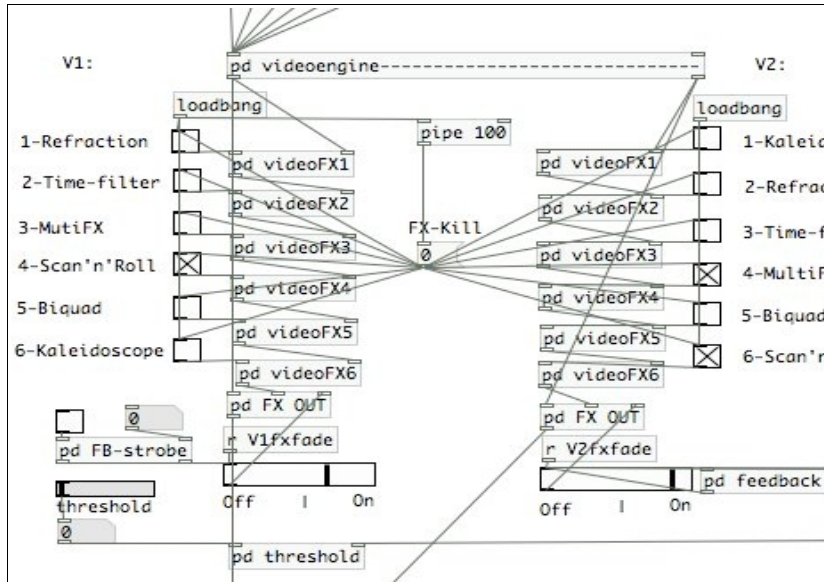


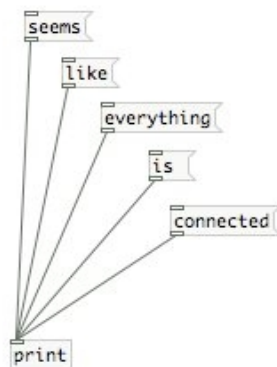
Figure 5-3: Part of video-engine patch for East is Red.

Pure Data is overwhelmingly crucial for AVLCS/East is Red: All control mechanisms, mapping of parameters, feedback, outgoing MIDI-information, visual analysis and analysis of audio signals is all taking place inside PD. The database of media elements (video clips) is constructed and organized in PD and the generative aspects of this work have everything to do with the PD-patch. The system-engine represents the brain of the project and is constructed in PD. The system engine is in addition a *compositional engine*, and since this project is founded on creating a non-linear audiovisual composition, it goes without saying that PD is of crucial importance. In other words, there would be no project without PD.

The importance of the system-engine as a compositional engine illustrates in a broader sense the extent of how my patches made in PD form an inseparable and inextricable part of the composition itself. No PD-patch, means no composition. The PD-patches of East is Red (or any other project made using the AVLCS infrastructure) interlocks with interchangeable media elements and virtual instruments and function together as a united instrument for composition. The very nature of graphical programming environments allows for an embeddedness in which the system structure and media content fuse and become inseparable. The system-engine becomes interwoven into the fabric of the composition and this ultimately leads to a blurred relation between functions of the composition and functions of the system in general. Furthermore, the picture gets even more blurry if the system is additionally configured to receive external interaction.

This raises questions of how such works should be defined; as instruments, compositions or something in between. These questions have become important in the development of the thesis framework, and has led to defining East is Red as a *composed instrument* (see 3.8).

While emphasizing the importance of the system-engine, the patches and the graphical programming environment itself, it's crucial to understand that all parts of this project are equally important because as a project it relies on a symbiosis of all active components. The project as a whole falls apart if one of the components is removed. At least the concept falls apart. The PD-patches of the system-engine wouldn't matter at all if for instance the audio engine was to be removed. Not a single sound would be heard because the sounds takes place externally in the audio-engine constructed in Propellerhead Reason (see 5.8). Nothing would be seen and the project would no longer have a visual component if the database of video clips was to be removed. The bottom line is that all parts of the project are codependent and interconnected. Interestingly enough this may illustrate the beauty of PD; it opens up the possibility of developing cross-application projects, it allows the user to twist and bend the structure of a project, projects can be customized to suit, mirror and reflect the user's creative thinking. The creative thinking becomes imposed into and embedded in the actual projects. It becomes not only a tool or an instrument, but *an artistic extension* of oneself.





### 5.3 AVLCS + East is Red = True

It was established in the introduction part of the thesis that this project consists of two elements: AVLCS and East is Red. The latter being an independent composition, or more precisely a composed instrument, which is facilitated by the underlying infrastructure provided by the former.

Metaphorically speaking AVLCS represents the skeleton while East is Red represents the flesh on the bones. The media elements; video clips, instruments, sounds and samples provide content, identity and meaning to AVLCS. AVLCS is only a technical construct with no purpose without the identity provided by this audiovisual material. Moreover, East is Red is basically a pile of unstructured media elements laying about with no purpose nor organization without the structure of AVLCS. This implies a symbiotic relationship similar to that of the composition and its means of delivery; the system-engine. (Elaborated upon previously in 5.2.5 ). East is Red is inseparable from the larger infrastructure of AVLCS, whilst AVLCS is dependent on East is Red, or the identity (sum of all media elements) of another audiovisual project, to make any sense as a composition. This notion can bring attention to the fluidity and translatability of diverse media elements which characterizes the digital medium itself [46]. The interchangeable media is what “breathes life” into the system, not only providing an audiovisual aesthetic identity, but also as data (from video analysis, sound analysis etc.) which drives the system-engine itself.

*Note: The codependence is not entirely a black or white situation because there are specific modifications done to the system structure which are exclusively adapted for East is Red. Another “project-identity” would require its own modifications to the infrastructure. After all this is an artistic project dealing with compositional issues, and not the development of a product with certain requirements. However, the information provided is conceptually accurate and meant to make sense in the thesis context.*

### 5.4 Modes of Operation

The AVLCS infrastructure can be adapted and customized to function in various scenarios relevant to my work with audiovisual multimedia productions; for instance as a performance instrument or as an engine for interactive installations. It's also intended to be used as tool for continued experimentation and research into generative, non-linear composition in general.

AVLCS operates under the influence of three different modes. The use of these modes depends on how AVLCS is configured. East is Red is an independent audiovisual work facilitated within the multi-purpose infrastructure of AVLCS and the configuration used for East is Red is characterized by the combination of two basic modes of operation which will be described in this chapter. The autonomous mode was intended to be the primary mode explored in the context of this thesis, but the process leading to the development of East is Red shifted the emphasis towards a combined semi-autonomous and performance mode. A third mode of operation will also be outlined because it's part of the AVLCS infrastructure and was in fact the starting point of the thesis. The third mode is no longer a part of the current thesis production and will only be outlined briefly. However, it's still a conceptually relevant part of the project and helps in creating an understanding of the multi-purpose intention of AVLCS, as well as pointing to possible future developments of this work.

### 5.4.1 Autonomous Mode

This mode is the “standalone” version. The composition unfolds in an autonomous form with no external influence or interference. The non-linear, generative and algorithmic qualities are the crucial aspects of this mode. The composition unfolds in a manner where chance-based events are intervening with an organized system-structure, creating a juxtaposition between chaos and order. All events, actions and reactions of this mode take place inside a closed system with no external influence (except starting and stopping).

### 5.4.2 Performance Mode

This mode is used for real-time audiovisual performance and allows the performer to override events taking place inside the closed system and replace them by external actions through the use of an interface. Certain aspects of the composition can be left automatized, either in a structured or a chance-based manner, whilst other functions can be taken over by the performer. There is a dynamic relationship between the human factor and the machine/system present in this mode. This mode can be adjusted and customized by assigning varying degrees of autonomy to the compositional engine.

### 5.4.3 Installation Mode

This mode is used as an engine for responsive, interactive installations. This mode is still conceptually relevant albeit not part of the current thesis production. The starting point of the thesis was based on an installation in which a compositional engine was to be used in an responsive audiovisual environment. External influence is introduced to the compositional engine by actions and movement of audience-participants. This mode relies on the use of motion tracking technology and sensor technology. The idea is to create compositional responses to external actions, or rather, external behaviour.

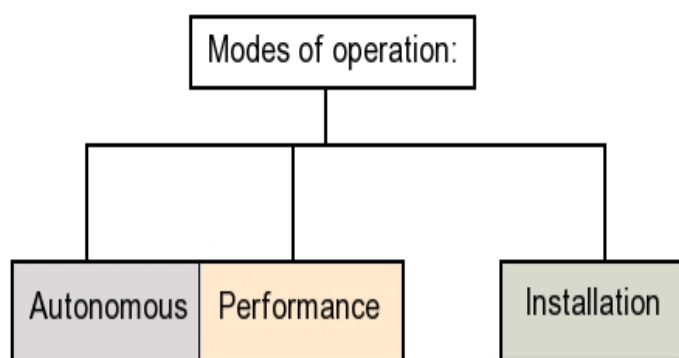


Figure 5-4: Modes of operation.

#### 5.4.4 Modes of Operation in East is Red

East is Red operates under the influence of the autonomous mode and the performance mode. This means that generative and algorithmic aspects of composition are combined with expressive real-time performance features and in essence turning East is Red into a composed instrument. The idea behind this combined mode is to facilitate a situation in which the performer can influence; interact, play and modify the generative composition in real-time. It doesn't mean that all internal functions and behavioural aspects of the composition are taken over by human intervention. This thesis is founded on the idea of investigating systems-based approaches to composition and art-making, the chance-based generative elements are embedded as part of the very fabric of this system and therefore not meant to be completely replaced by external influence in any mode. Basically East is Red hybridizes the autonomous and the performance modes and this results in a semi-generative playable composition; a composed instrument.

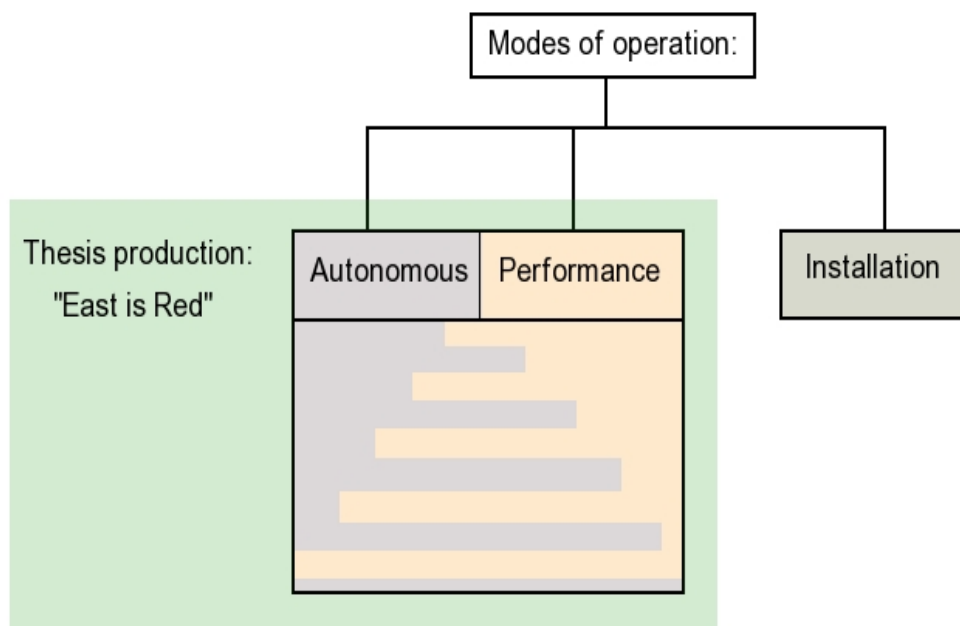


Figure 5-5: Modes of operation in East is Red.

#### 5.5 Behaviour

The term behaviour is used to describe actions and reactions of objects or organisms. The actions and reactions in question are seen in relation to the environment of the object or organism. Behaviour is also a term used in computer science and useful in this context because it has traditionally been applied to animals and living systems but also with studies in artificial life and autonomous agents [47].

The modes of operation presented in AVLCS/East is Red make more sense when seen in a behavioural context. AVLCS operates under two behavioural influences, Internal and external behaviour. The term *behaviour* in this contexts suggests influence, action and reaction; the internal "life" of the composition and how this can be influenced via external means. The autonomous mode is purely governed by internal behaviour with no external influence whatsoever. Both the performance mode and the installation mode are characterized by a symbiotic relationship between external and internal behaviour.

However, the level of external influence is adjustable and customizable, making it possible to decide, depending on what type of configuration of AVLCS, on how much the internal behaviour will dominate and to what extent external behaviour is allowed to influence the “inner life” of the composition. East is Red is the basis for this thesis production and, as mentioned previously, represents a hybrid mode in which a performer interacts and engages with the compositional engine in a semi-autonomous state, allowing for control and manipulation of the composition yet letting certain functions remain in a chaotic and chance-based state.

### 5.5.1 Internal Behaviour

Internal behaviour is categorized by all algorithms, internal set of rules, feedback mechanisms, analysis, sub-level programs, chance-based events, randomization and chaotic responses of the compositional/system-engine. It's how the composition responds to either external events, or responds to data extracted from the media elements and the output from both the video-engine and the audio-engine. The access to the databases, both video and sound, is ruled by internal behaviour. It represents the inner workings of the system engine, the machinery responsible for producing the real-time audiovisual non-linear composition, and without internal behaviour the composition wouldn't exist.

### 5.5.2 External Behaviour

External behaviour is categorized by all external influences interacting and interfacing with the system-engine, depending on the mode of operation in question. On a conceptual level anything which can register data outside the closed system, and then transfer that data by interfacing with the internal system, can be defined as external behaviour in this context. Most likely options in reality would be to use a form of instrument as source of influence in the performance mode and a combination of motion tracking and sensor (i.e ultrasound) technology in the installation mode. A MIDI-keyboard is the interface used for providing external behaviour in the case of East is Red. Various parameters and controls are mapped onto keys, sliders and knobs of the keyboard.

Modes of operation:	Autonomous	Performance	Installation
External behaviour:	none *	performer actions	audience actions; movement, proximity
Interface:	none	instrument (i.e MIDI-controller)	camera (motion detection), sensors (i.e ultrasound)

\* Except turning on/off



Internal behaviour

Figure 5-6: Modes and behaviour.

## 5.6 System-engine

The internal behaviour is represented by the sum of all the actions and reactions occurring inside the system-engine. The system-engine is also where influence from external sources, if any, interacts, influences and modifies the internal behaviour. But the system-engine represents a lot more: It's the organizing "brain" of the whole project, the primary driving force of the audiovisual composition. As a matter of fact there are no distinguishable differences between the system-engine as a technical, organizing construct and the role it plays as a compositional-engine. The system-engine is the equivalent of a musical score on sheet, a sequencer timeline or a video-editor timeline. However, the differences are fundamental: The system-engine processes information in real-time, producing a non-linear environment characterized by temporal fluidity as opposed to linear environments where the temporal aspect is already set. The system-engine functions on a multi-dimensional level; multiple actions and reactions take place on multiple levels simultaneously. Furthermore, the system-engine is where all logistic tasks occur; all internal and external communications and data distribution. The system-engine is the organizing principle which brings together the databases and algorithms for composition, outputs data (MIDI), analyses video and audio, has a GUI (graphical user interface) for control and visual feedback and binds together the video-engine and the audio-engine into a hierarchal structure. The system-engine is entirely based on the graphical programming environment Pure Data.

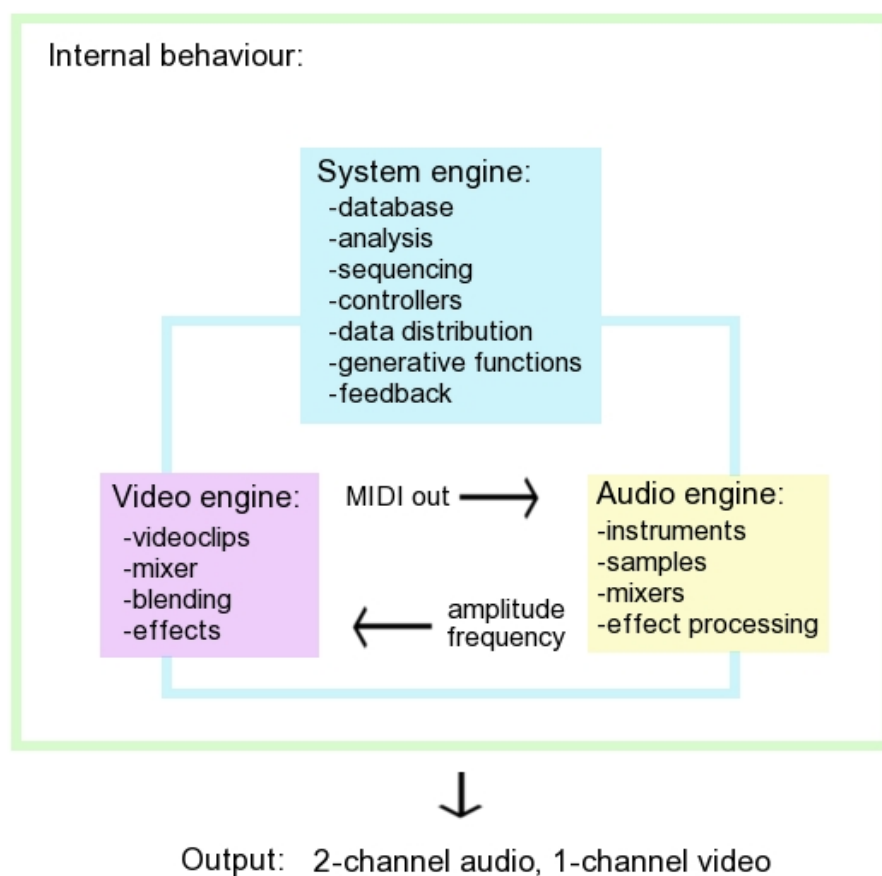


Figure 5-7: System-engine.

### 5.6.1 Preset-programs: Chapters

Preset-programs, or “Chapters”, represent a collection of different commands being triggered simultaneously, producing a particular audiovisual signature. A chapter can for instance trigger a particular video-bank, with an individual effects signature, a certain mixer setting and a particular instrument and sound-bank in the audio-engine.

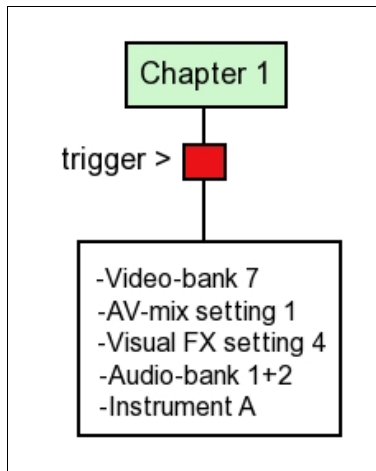


Figure 5-8: Example of a Chapter.

Chapters are more than just preset buttons, they are integral parts of the compositional aspects of the system-engine, and when triggered, set into motion chain reactions which have an immediate audiovisual impact. The preset-programs are integrated as a part of the system-engine and function regardless of mode of operation. In a compositional sense they are situated on the macro-level; starting sequences, multiple events and combinations of events, as opposed to single events occurring on the micro-level. Chapters are used to drive narrative content and trigger thematic events.

### 5.6.2 Multi Buttons

Multi buttons have a similar function to Chapters, triggering single or multiple events simultaneously, but not particular content banks from the database. Combinations of settings are quickly changed using multi buttons, but the narrative and thematic content remains. A multi button might for instance trigger effects settings or global settings (such as colour, volume etc.).

### 5.6.3 Multi Controllers

Multi controllers are, like Multi buttons and Chapters, connected to multiple simultaneous actions and trigger multiple simultaneous events. The difference is that Multi controllers control a number flow within a minimum and maximum range. Multi buttons and Chapters only work by turning on or off a chain reaction of events. For instance, a Multi controller called “Glitch1” controls gradual scaling of the image, gradual in/decrease of a particular visual effect and volume of its designated synthesizer in the audio-engine. All these events take place simultaneously by sliding the multi controller and the audiovisual result depends on the amount of action. Multi controllers are linked to sliders that can be adjusted in performance mode via a MIDI controller or by using the onscreen GUI, or connected to line objects (time based de/increasing of number flows) when used in the autonomous mode. Multi controllers play a prominent role as individual instrument parameters, and although embedded in all modes of operation, they are especially effective in the performance mode and can be used expressively to create major alterations of the overall audiovisual composition. Multi controllers, Multi buttons and Chapters are all connected to chance-based operations of the system-engine as well.

## 5.7 Video-engine

The video-engine is situated beneath the higher functions of the system-engine in the hierarchy of the project. Metaphorically speaking, if the system-engine represents the brain of the project, the video-engine represents one of the arms. As the name suggests, the video-engine deals with video and all things visual. The video-engine is partly a video-mixer which, through the higher level functions of the system-engine, can access the database and it's also partly a visual effects processor.

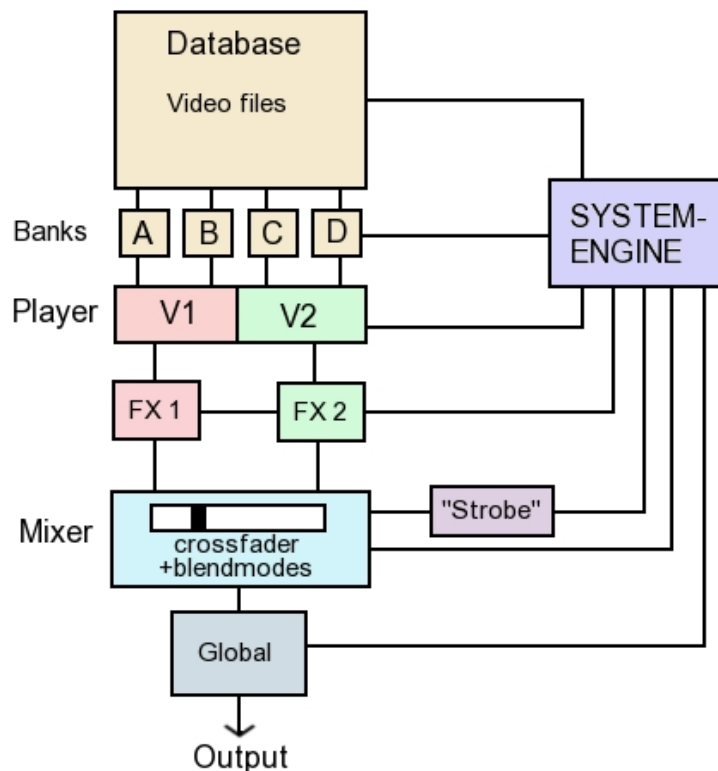


Figure 5-9: Video-engine.

### 5.7.1 Video database

The video clips are organized into 24 banks each containing between 8 and 20 video files. The 24 banks are duplicated to provide a set of 24 banks for each of the two video channels, making  $24 \times 2 = 48$  banks available in the mixer section. The banks are grouped according to thematic and/or aesthetic criteria, i.e. "Shanghai1" or "Chengdu streets". Each of the banks can be played back in a sequential order, a random order or as single repeating clips. A bank of clips will keep repeating if the sequential order is chosen, unless the *stream mode* is activated: The stream mode links one bank with the following bank; when the last frame of the last clip in bank 1 is finished, bank 2 starts to play its first clip and so forth. It's fully possible to access either a whole bank, or any given clip in any given bank or access any video file, outside the bank-structure, anywhere from the computer's hard disk.

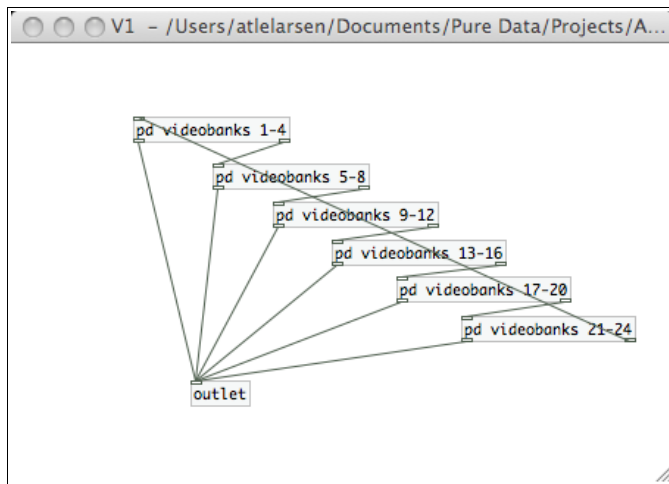


Figure 5-10: Part of the bank structure.

### 5.7.2 Video Player

Video clips get loaded into a player that can serve two video clips simultaneously; one for each channel. Various controls are connected to the player such as speed control and picture delays (used for video “scratching”). Both the speed control and picture delay are connected to higher level system-engine commands and play a role compositionally. The secondary function of the video player is to output a trigger signal on the first frame of any clip playing. (The last frame is also used but less frequently.) The two trigger signals (from video 1 and 2) are used throughout the system-engine, and since all clips are of different duration and the order of activated video banks keeps changing, it ultimately becomes a source for producing chance-based events that are routed to trigger different functions throughout the system-engine. The first-frame trigger signals are also routed to the MIDI-section, and here system-engine commands determine whether to use the first-frame signal to either send randomized or targeted sample triggering information to an instrument in the audio-engine called the V1/V2-Sampler. (See 5.8.4).

### 5.7.3 Motion Detection

Any currently loaded video-clip is subjected to motion detection. The motion detection unit calculates the mass gravity of movement in video files and outputs number values for the x-axis and the y-axis, calculated in accordance with resolution of the video-clips. All video clips used in East is Red are 640 x 480 pixels. It's possible to set threshold level to adjust the sensitivity of the motion detector. The number data from the motion detector is predominantly sent to the MIDI-engine for output to the audio-engine, but the number streams are also used elsewhere in the system-engine. There is also a function for splitting the image screen into 9 sectors and transmitting whichever sector is activated. However, the sector analysis feature is not currently used in East is Red. The motion detector always uses the current visual output for analysis. This is significant because the “motion signature” of a video clip will change drastically when subjected to visual effects and manipulation.



### 5.7.4 Effects

Output from the banks is routed, as video-channel 1 (V1) and video-channel 2 (V2), to the visual effects section. Each channel has a selection of 9 effect units to be used either as single effects or as combinations of effects. At the end of effect stage there is a level controller making it possible to decide whether to turn effects off or adjust the strength anywhere from 0-100%. Each effect unit has a number of available parameters for manipulation and a selection of these effect-parameters are connected to higher level functions in the system-engine. Upon leaving the effects stage, the signal flows through threshold controllers and motionblur controllers before ending up in the video-mixer.

### 5.7.5 Video-mixer

The video-mixer is characterized by a crossfader and blending options. The main function of the mixer is, of course, to mix incoming channels. Blending is a way of compositing two signals by utilizing mathematical operations. Every time the fader reaches one of the opposite ends, either channel 1 or channel 2, a trigger-signal is created and subsequently sent to the audio-engine. The crossfader is also connected to a component called the “Strobe” which is a sub-patch sending fading commands. The Strobe tells the crossfader to switch back and forth between video channel 1 and 2 when activated. Fading time is adjustable allowing for either slow picture fades or fast bursts toggling back and forth between the two channels creating a strobe-like effect. Furthermore, the Strobe contains programmed sequences that can either shift between channels in a regular or randomized fashion. The Strobe and its sequences is used as a compositional tool, and it receives trigger signals from higher levels in the system-engine for instance when synchronized with the Chapter programs (Multi buttons). The actions of the crossfader is synchronized with a corresponding effect in the audio-engine. More on that in the audio-engine chapter.

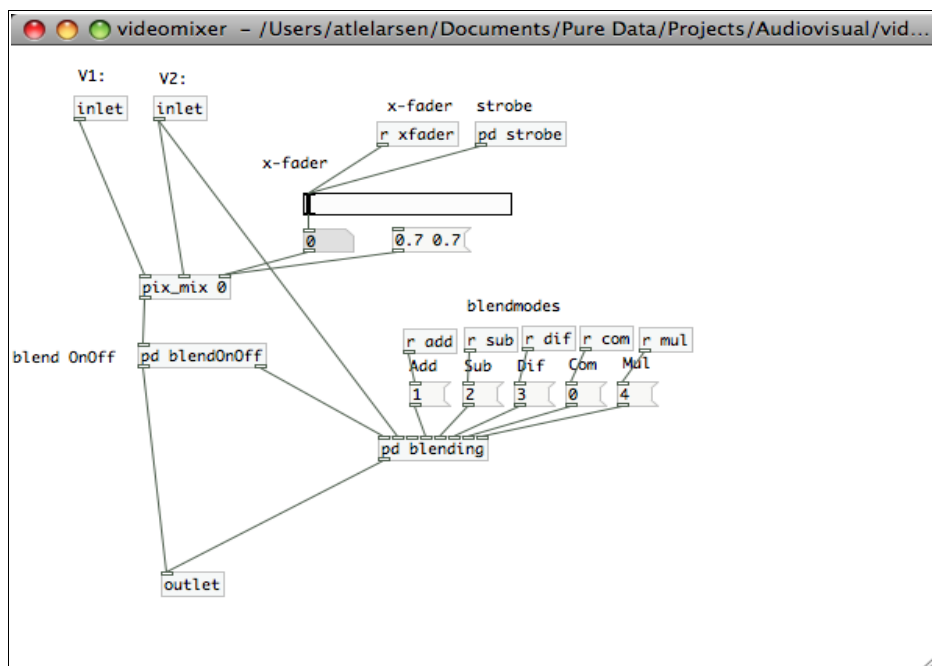


Figure 5-11: Videomixer sub-patch.

## 5.7.6 Global Controls

The signal leaves the mixer stage as a united signal of both video channels combined and continues by going through a series of global controls:

- Translation, scale and rotation. Geometric actions affecting the screening surface.
- Colour-control
- Global effect (time-filter).
- Global image cropping. Incoming amplitude signal is used in combination with the cropping for a visual effect. Can also be controlled manually.
- Global motionblur/feedback
- Global layers: Duplicates of the entire mix are used as overlays. These duplicates are distorted in size and follow the movement patterns extracted from the motion detection unit.

After going through the global controls the signal is finally being sent to the main video output.

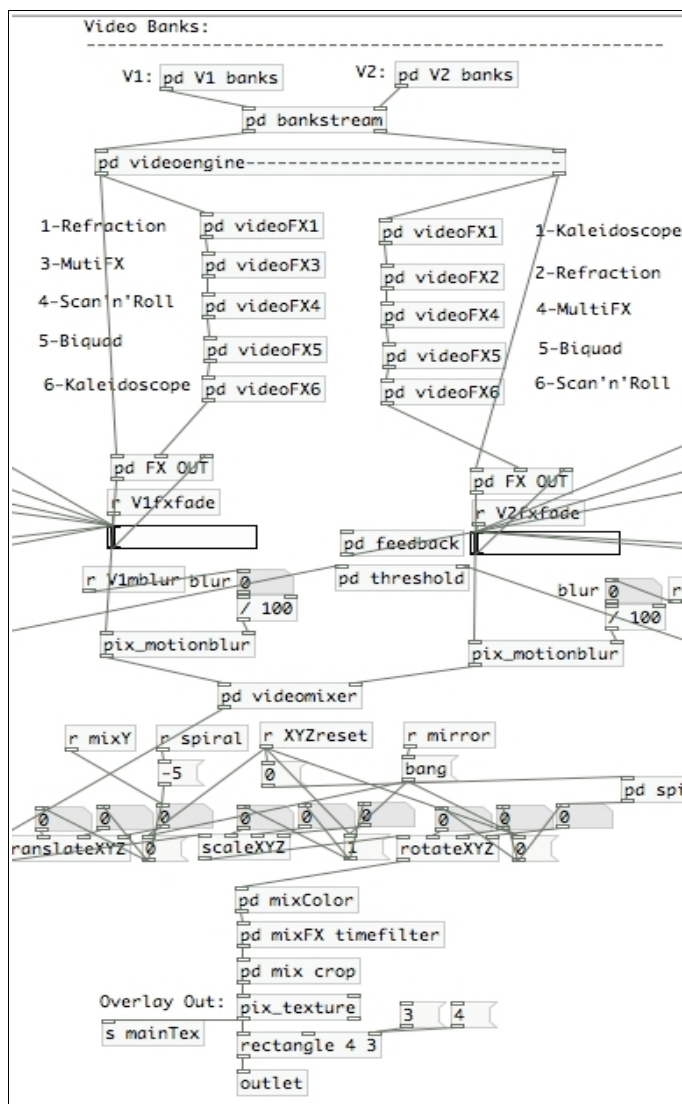


Figure 5-12: Part of the video-engine.

### 5.7.7 Screenshots of East is Red



Figure 5-13: Screenshots from East is Red.

## 5.8 Audio-engine

The audio-engine represents the other arm of the body-metaphor and the following chapter elaborates on the components, mechanisms and inner workings of the audio-engine. It's worth reminding that functions of the system-engine, video-engine and audio-engine are interwoven and that these three engines form a united “compositional engine”. This chapter will therefore contain information that in the overall context of the thesis is directly linked to compositional concerns, and will to a certain degree overlap and elaborate on information presented previously and in the coming chapter on *generative principles* of the composition (5.9).

The audio-engine is situated externally in an application for production of electronic music called Propellerhead Reason. All data and commands are transferred from the system-engine (Pure Data) to the audio-engine (Reason) via the MIDI-protocol. The chart below shows the signal flow; incoming MIDI-messages, the description of an example instrument and the output of audio.

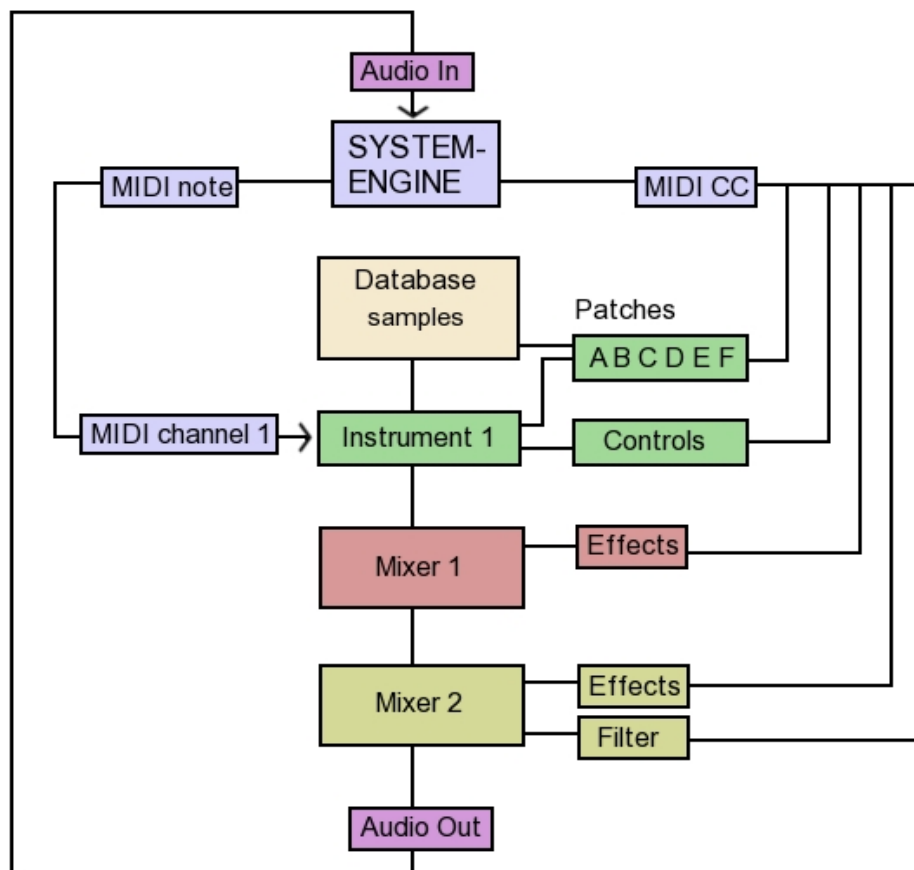


Figure 5-14: Screenshot of the audio-engine of East is Red (with one instrument as an example.)

### 5.8.1 “Reason For Choosing Reason”

“The virtual studio” is the analogy used to describe Reason, and this application is an attempt of creating a software environment which literally resembles a customizable hardware studio filled with synthesizers, mixers, effects, samplers and drum-machines<sup>42</sup>.

Reason is a powerful musical tool and I have become very familiar and fond of working in this software environment over the years. Reason is a relatively simple application to get started with, providing short distance from idea to actual music, and remains a very popular package for music making worldwide. Reason is, as mentioned, molded around the idea of a “virtual studio” and it became a logical progression for me musically with regards to my background and experience from a hardware-based home studio. Over the years I have discovered that although the software is easy to get started with, it still allows for musical progression and expansion to deeper and more sophisticated levels of musical composition. Reason can be, if used “properly”, a very powerful and effective tool not only for linear music, but also for non-linear composition. I have used Reason as the main audio component in experiments with non-linear composition and generative sound art since 2006.

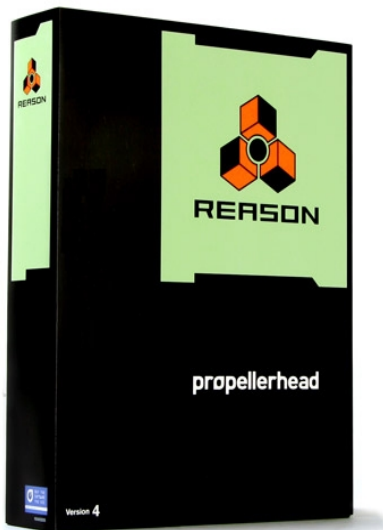


Figure 5-15: Propellerhead Reason 4.0

Reason is a MIDI only production suite with no “real audio” involved. The lack of DSP (digital signal processing) is in my opinion the greatest downside of Reason. Other limitations related to Reason has surfaced during the development process and in turn shaped the overall development of the system-engine and had an impact on overall usability as well as compositional concerns. However, the strengths of this application does to a large extent outweigh its weaknesses, and upon deciding to use Reason as audio-engine, the design of the overall infrastructure became adapted to the characteristics of this particular software.

This project could have been made using other MIDI-compatible audio software solutions such as Ableton Live<sup>43</sup> or Reaktor<sup>44</sup>. Future implementations of AVLCS may very well utilize other audio applications, or instead rely fully on an internal audio-engine constructed inside the system-engine. The most likely approach will probably resemble the solutions from East is Red but with a downsized external engine and a stronger focus on an internal DSP-based engine.

<sup>42</sup> <http://www.propellerheads.se/products/reason/>

<sup>43</sup> <http://www.ableton.com/>

<sup>44</sup> [http://www.native-instruments.com/index.php?id=reaktor5\\_us](http://www.native-instruments.com/index.php?id=reaktor5_us)



## 5.8.2 MIDI

MIDI (Musical Instrument Digital Interface) is a technology that allows for communication between electronic instruments and computer-based systems for playing and creating music. It was created in 1983 and is closely tied to the development of music synthesizers. MIDI devices communicate by speaking the same "language" of MIDI. This language is in many ways an electronic counterpart of sheet music: MIDI messages are used to describe what notes are played and for how long, determining the tempo, which instruments are to be played and at what relative volumes. MIDI data is only instructions for performance, not a digital version of a sound recording. MIDI data is transmitted electronically between MIDI-compatible musical instruments, and the resulting performance depends on how the receiving device interprets the performance instructions, in the same way that a human performer would read sheet music. The MIDI Message specification, the "MIDI protocol", is the most important part of MIDI. The protocol is a music description language in binary form and originally designed for use with keyboard-based musical instruments and the message structure is oriented to performance events [48].

### 5.8.3 MIDI Section

All MIDI data is handled in the MIDI section of the system-engine. Incoming number streams, video analysis data and trigger signals of all kinds are routed to respective MIDI channel outputs before being transmitted to the audio-engine. The incoming signals are treated with various algorithms, depending of which recipient instrument and function in question, ranging from randomizing-objects, note-set selectors to line objects (creates time-based in/decrease of numbers).

The two main types of MIDI-information sent from the system-engine to the audio-engine in Reason are Note Out messages and Continuous Controller messages. These two types of messages have three functions inside the audio-engine:

- Note messages (note out) have values from 0-127, which translates to notes from C-2 to G8 on a keyboard, and are received on multiple MIDI channels and used on multiple instruments to trigger notes on synthesizers and to trigger samples in the sample-players of Reason.
- CC-messages send 0-127 values and are transmitted to various control-parameters on the various instruments and devices in the audio-engine, such as filters on synthesizers, faders and panning on mixers and dry/wet-level on effect processors.
- CC-messages are also used to change patches on different instruments. ("Patch" in Reason refers to a factory preset or a user created program which can be loaded for each instrument device inside Reason). Custom made patches are stored in the same folders and can subsequently be toggled, from one patch to the next, inside each instrument. This is a way of economizing the audio-engine and changing of patches also plays an important compositional role as a chance-based mechanism.
- In addition Pitch bend messages and modulation messages are sent from the system-engine to control corresponding functions on a select few instruments.

## 5.8.4 Sample-bank Structure

Sample-players form a very important role in the audio-engine: Collections of samples are stored as patches and accessed by CC-messages, making a large collection of sample-banks available in the composition, either as individual banks or as combinations of banks. The samples used in the sample banks are organized by thematic content and range from site-specific recordings from China, instrument recordings to collections of short hits, sound effects and synthetic sounds.

At the heart of the sample player structure lies a mixing-instrument created by combining two sample-players and in which the crossfading between these two players is synchronized with the video-mixer in the video-engine. This combined instrument/mixer is called the “V1/V2-Sampler” and the two joined players represent respectively audio channel 1 and 2. A trigger signal is sent to the V1/V2-Sampler whenever the video-engine crossfader shifts between any of the two corresponding video channels in the video-mixer, resulting in MIDI-messages transmitted for sample triggering in the V1/V2-Sampler. Naturally, the audio-engine responds by fading volume between the two channels when crossfading as well. Settings in the system-engine can determine whether to send a random trigger signal ranging from 0-127, or a fixed number note signal. Each of the two combined sample-players of the V1/V2-Sampler also receive CC-messages for patch changes which makes it possible to access their respective folders of custom made patches of sound-banks. The folders contain patches which represent unique and varying sonic identities, where the change from one patch to the next yields a change of audible identity. However, many of the patches in the folders are designed in what could be described as *family structures*: These patches are designed as variations on themes with only slight changes from one patch to the next, making more gradual sonic variations over time and producing reoccurring sound patterns.

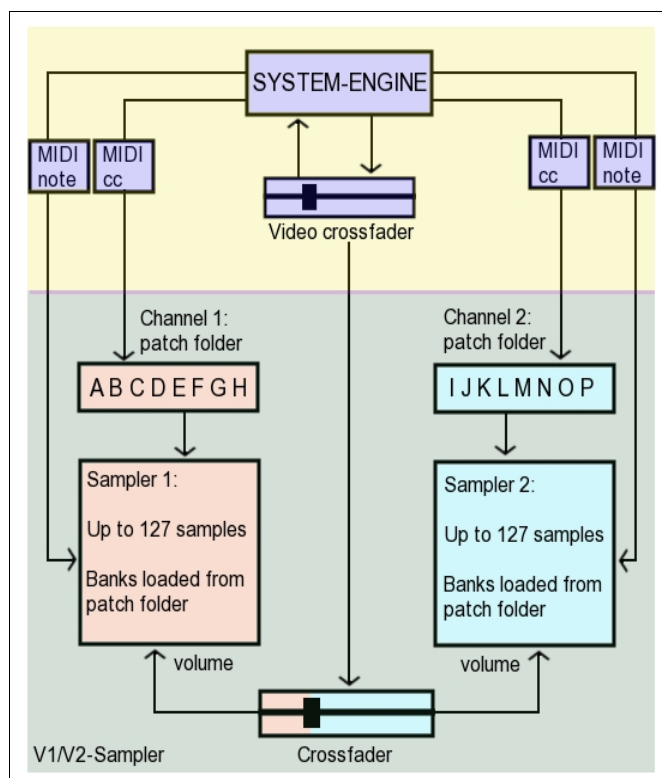


Figure 5-16: V1/V2-Sampler.

#### 5.8.4.1 Chance-based “Shuffling”

The V1/V2-Sampler is the cornerstone of the chance-based mechanism in the audio-engine. The chance-based operations of the V1/V2-Sampler occur on 3 levels:

##### Level 1:

Each MIDI-note sent to the sampler can be given a random function in the system-engine. The random numbers will typically be in the range from 0-127 representing keys from C-2 to G8. Each MIDI-note sent will subsequently trigger a random sample within the currently loaded patch in the V1/V2-Sampler. This applies for both channels/both sample-players of the V1/V2-Sampler, but only the active channel is audible. (*Note: Random at this level is optional and it's possible to choose to send a fixed MIDI-note from the system-engine for a predictable sample to be triggered.*)

##### Level 2:

The second level of chance-based operations in the V1/V2-Sampler takes place when the patches (sound-banks loaded into the instrument) are changed. The system-engine can either send a CC-message for choosing the next patch or the previous patch. Every time the V1/V2-Sampler receives this message the next (or previous) patch in the folder will be loaded, and when all patches of the folder have been used, the process will start over by loading the first patch in the folder. What this means in practical terms is that there is constant changing, shuffling and reshuffling of which banks are activated at any given time. Over time the patches loaded from the folders become deliberately out of sync and will constantly yield new combinations and juxtapositions of sample-banks between the two audio-channels.

##### Level 3:

The third level of chance-based events courtesy the V1/V2-Sampler is represented by all level 1 and 2 desynchronization which in the larger compositional scheme will align, combine and juxtapose unpredictably with other events occurring elsewhere in the overall system infrastructure. This approach of constantly *shuffling media elements* is conceptually important in this project as it creates indeterminacy and highlights chance-based operations as a compositional method. It becomes a method (especially when combined with other generative principles) of throwing dice, so to speak, in order to create chance-based alignments and juxtapositions of different samples from different sample-banks, and to create chance-based alignments with other instruments in the audio-engine, with visual elements and in the greater context contributing to the chance-based characteristics of the whole audiovisual structure.

*Note: Even though the information above applies to all modes of operation of AVLCS, it's most relevant when viewed in the light of the autonomous mode. Shuffling still occurs in the performance mode but human decision making can partly override this mechanism.*



### 5.8.5 Ordered Sample-players

The balance between chaotic and ordered elements is a fundamental governing compositional principle in this thesis project, and the V1/V2-Sampler represents a disorderly and chaotic element in the compositional structure. Several other independent sample-players in the audio-engine are operating in an ordered manner to counterbalance this chaotic aspect. These players, and their respective patch folders, are organized and synchronized with predictable events and with visual themes emanating from the system-engine. For example when specific programs (Chapters) are activated in the system-engine, such as “Lhasa” or “Shanghai”, corresponding banks like “Lhasa-samples” or “Shanghai-samples” will be activated in the audio-engine. These players do also have the possibility of randomizing individual note triggering, but that randomization always occurs within the same thematic context.

### 5.8.6 Additional Instruments

The motion data extracted from visuals is transmitted via MIDI and assigned to control pitch of two instruments in the audio-engine. (Motion detection data is used for other purposes as well in the audio-engine, but pitch control is the main task.) The range of pitch-data can be set in the system-engine as either a “free” stream of numbers or organized into “note sets”. A note set is a way of asserting some tonal control over the free stream of movement data translated to pitch. Note sets only output within a range of predefined note values. The free stream is a clean stream of number values between 0-127 derived directly from the movement analysis:

0 = lowest y-axis value = lowest pitch, 127 = highest y-axis value = highest pitch.

*(Note: There is now law saying that image-to-sound data should be mapped in this manner, although it does make sense: Up equals high pitch, down equals low pitch.)*

Movement data is transmitted to the audio-engine and routed to two instruments:

1) A synthesizer, 2) A combinator<sup>45</sup>. The combinator is used for drum hits, effect sounds, arpeggiated patches and synth patches. Both these instruments receive patch-change commands from the system-engine which can be adjusted between the chance-based *shuffle* mode and an ordered mode.

Translating movement data directly to pitch (or other parameters) creates a strong and recognizable connection between image and sound and is a very efficient way of establishing a tight audiovisual relationship in the composition.

### 5.8.7 Audio-engine mixers

The signal flow of the audio-engine is organized using two sets of mixers. The first mixer deals with all the individual instruments. The output from the first mixer is sent to a second mixer. The second mixer receives global changes, changes affecting the whole mix as opposed to individual instrument changes. This means that the signal from all the instruments in mixer 1 can be treated simultaneously in mixer 2, for instance by applying an effect. The actions of the second mixer are synchronized via MIDI with global changes taking place in the system-engine.

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<sup>45</sup> Combinator is an instrument in Reason allowing for the combination of many single instruments to one.

### 5.8.8 Mixing as a Compositional Method:

Mixing provides a way to blend, overlay and toggle between both channels of simultaneous sound and video. In addition mixing is used as a “driving force” of the system-engine and has an important compositional role in this project. The crossfader is not only used for fading between A/V-channels, it also generates sound by sending out trigger signals connected to the V1/V2-Sampler. Coherence and narrative structures can be established by using mixing as a compositional basis. This approach can in many ways be compared to how DJ's or VJ's construct “narratives” by mixing; combining, blending and juxtaposing elements and, through seamless transitions, manipulate the temporal aspect. Mixing as a technique is only a part of this project, but it does play a role in the overall understanding of the system set-up and of how mixing can be used as a approach to composing.

By utilizing mixing, either generated by the system, by performer action or in combination, the musical characteristics has taken the shape of a *soundscape*: Collages of sound merging, drifting apart and making gradual variations on themes. These characteristics have emerged naturally in the development process as a consequence of the integration with the system-engine and visual composition. Indeed this project is an *audiovisual* composition and both audio and the visual domain should be interpreted by their symbiotic relationship and interplay.

### 5.8.9 Feedback Loop - MIDI to Audio Cycle

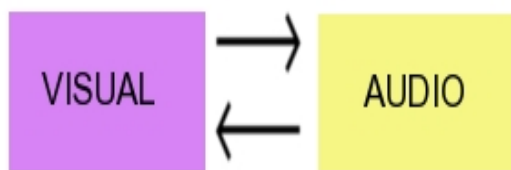


Figure 5-17: Audiovisual feedback loop.

The amplitude of the signal produced by the audio-engine is received by the system-engine and used for triggering visual effects and manipulations, global changes and as a component in the generative engine. The responses of the amplitude data affect the visual output which is continuously interpreted by the system-engine (motion detection), and subsequently the system-engine transmits this interpreted data via MIDI back to the audio-engine again, resulting in a continuous change in the audio profile. This MIDI-to-Audio cycle is a central part of the system infrastructure, providing an internal feedback correlation between system-engine functions, for instance data from motion detection, and audio-engine functions. The cycle continuously gets repeated in a modified manner; amplitude data affects visual parameters which subsequently produce a sound response, and so forth. The end result is a cyclical changing pattern of continuous variation of sound and visual compositional parameters; an internal looped chain reaction. This is the outline of how the cycle works in principle. Experience so far suggests that the perceivable results of this mechanism can be difficult to detect because the variations occurring are relatively similar in nature. However, it does play an important role as a driving force inside the compositional structure. (*Note: Analysis of the frequency of the audio signal can be used in a similar manner to drive mechanisms inside the system-engine, but this feature is not implemented in the thesis version.*)

## 5.8.10 Audio-engine Screenshot



Figure 5-18: Screenshot of East is Red audio-engine.

## 5.9 Generative Engine

The so called generative engine of AVLCS/East is Red is not one particular part of the system set-up as the previously described engines, rather it's a collection of different features, of events taking place and data causing effects throughout the system, and ultimately how these features and events together influence and govern the actual non-linear composition. It would actually be more appropriate to talk about *generative principles operating within the system-engine structure* than a to talk about a separate engine. However, using the word engine makes sense when analyzing the project since the term has been used to define the system, video and audio-engine already, and since the generative principles operating within the system infrastructure belongs to a conceptual “compartment” of their own.

The combined results of all the processes taking place in the generative engine have an impact on the audiovisual content, and all events put together and in combination with the databases, constitute the audiovisual composition as it unfolds in either a generative, autonomous state or in a semi-generative performed state. The common denominator is that all these events happen in a more or less chance-based environment, and that these events ultimately govern the audible and visible results making up the composition. The other common feature is that, although there are a lot of chaotic elements involved within the system-engine and chaotic elements in the composition itself, there are always measures of order imposed as a counter balance to disorder. There are functions built into the system-engine keeping it in balance: (Optional) ordered sequencing and time-based “clocks” turning functions on and off over time. In the performance mode order can be deliberately imposed by performer actions. All of this ties in with the main compositional concept of balance between chaos and order, as well as reflecting my own personal aesthetic concerns.

### 5.9.1 Components of Generative Engine

The following section provides a list of the components which make up the generative engine of AVLCS/East is Red. The strength of the generative engine lies in the results of combining several methods, rather than the results of individual methods alone. This is a brief overview and recap; some of these functions have already been covered in other parts of the thesis.

- **The “Shuffle” method.** Constant shuffling and reshuffling of the content of the databases (both audio and video) and the instrument patch folders. This method creates chance alignments with constantly new combinations and juxtapositions of both video clips and audio-samples/sound sources. Furthermore, events from the visual domain are used to shuffle events in the audio domain and vice versa. All the shuffling takes place in an aesthetic “universe” defined by the author, but the constant shuffling still conjures surprises and combinations which are difficult to predict. The shuffle method is elaborated upon in more detail in the description of the V1/V2-sampler (5.8.4 and 5.8.4.1). The shuffling technique was first explored in “Lineage” (APPENDIX A).
- **“Clockworks”** with built-in random timers. Turning on and off various parameters throughout the system-engine. Also used for triggering video-bank sequences. The degree of randomness is adjustable.

- **A/V-crossfading:** Connects with the shuffle method, adding a new layer of combinations and juxtapositions to the media elements (sound and visuals) by toggling back and forth between A/V channel1 and 2. The crossfader sends trigger signals used within the system-engine and to trigger random (or fixed) sounds in the audio-engine. It's also possible to break the audiovisual synchronization and use crossfading on the video and audio channels separately. The strobe function triggers crossfading sequences which can be assigned to random timing values; both for fade-time (how long time is used fading from one channel to the other) and stay-time (how long time the fader stays in on channel before moving to the other.)
- **“Interrupters”:** Triggering of Chapters (5.6.1), Multi-buttons (5.6.2) and using Multi-controllers (5.6.3) all set off chain reactions (multiple events triggered simultaneously). The effects of these chain reactions are imposed on top of the settings used prior to triggering, but without fully overriding the previous settings. The chain reactions affect the overall audiovisual output when blending and combining with previously chosen parameters and settings.
- **Motion detection** of video clips and manipulated visuals. Each video clip has an unique “motion signature” and this data is used to control sound-sources etc. When visual content is being manipulated the motion data changes accordingly, which ultimately produces a wide range of constantly changing streams of motion data.
- **The feedback cycle:** Motion data from the visual output create corresponding responses in sound. Amplitude from the audio-engine has various effects when interpreted in the system-engine. Threshold controllers are used to route different amplitude levels to perform various tasks throughout the system-engine. Amplitude data is a result of visual information, and when reinterpreted by the system-engine, this amplitude data affects visual parameters yet again and subsequently a new sound response is produced, and so forth (see 5.8.9 for more).
- **Randomizers:** Pure Data has a built-in pseudo random number generator object. The numbers created from the random objects have major and minor tasks throughout the system, for instance sending a random trigger signal to the V1/V2-sampler.

## 6. Future Developments

First of all, I would like to continue working with new versions of East is Red. The present work produced for this thesis is a fully independent version, but the source material used for East is Red is extensive and unused material could very well make its way into new adaptations. I definitely see the possibility for making new versions and variations, and since the current version is a composed instrument, it would be interesting to develop a fully autonomous version of East is Red as a continuation of the work with generative principles. Furthermore, I would like to develop the system further because the current version still has a limited range of possible compositional variations. The current version works to a large extent by various variations on themes, and I would like to include elements to the system-engine which can produce a bigger repertoire of available compositional events and more “surprises”.

I would also like to find opportunities for performing East is Red in live settings since the current version is adapted for performance. Moreover, I plan on recording sessions of live performed compositions as a way to utilize all the flexible, chaotic and fluid features of the non-linear environment, coupled with human influences, but where the end result becomes a recorded linear representation of the composed instrument performance.

The next logical step of progression would be to use the AVLCS infrastructure to create an entirely new audiovisual composition, with different content and identity, emphasizing the aspect of interchangeable media elements as a way of providing meaning and identity into the system structure.

The last step would be to customize AVLCS to be used as a compositional engine for a responsive audiovisual composition. This could be done using East is Red for compositional content and identity, or by creating a new composition altogether. Most likely this would be a project emphasizing audiovisual expression in a spatial context, using cameras for motion detection and ultrasound sensors for proximity detection. The movements and actions of audience-participants would be transferred as external behaviour into the system-engine in order to create internal compositional responses. Adaptions of this set-up could be based on surround-sound and surround-visuals.

## 7. Conclusions

All in all this project has been a rewarding and challenging experience. The research done in order to create the contextual framework has proved to be very valuable. It has made me able to place my work and research into a much wider perspective by drawing knowledge and influence from different disciplines, and recognizing the traditions of non-linear approaches to art-making and composition. The ideas surrounding this thesis are part of a historical trajectory, and contemporary works using the tools of today can be better understood by viewing the larger picture. The contemporary trend of convergence between different forms of media and technologies can in my opinion benefit greatly from the knowledge drawn from the historical perspective, and it also coincides with a personal interest of facilitating convergence between various types of expressions. The contextual framework presented in this thesis is also relevant when regarding convergence from a multidisciplinary perspective: Algorithmic methods from musical composition can for instance be implemented in visual works; systems in interactive installations, or games, can be used for composing music etc.

Non-linearity, generative principles and systems-based forms of art and composition was the starting point of this thesis process, even though the development of *East is Red* as a composed instrument made the project “branch out” to include a greater emphasis on performative aspects as well. The underlying principles of generativity are still present in *East is Red* and has been colouring the whole thesis process from beginning to end. These principles are indeed part of the very fabric of AVLCS. The thesis process has also put forth interesting questions and observations on the nature of non-linear forms of expression: Non-linearity, generative principles and systems-based forms of art and composition might perhaps be considered more “natural” than the linear form and expression. Everything in nature is in constant flux, constant change takes place on the smallest and the largest scale in the universe. We ourselves are not static, but in constant change. The linear form on the contrary is “unnatural” because it represents ideas and concepts frozen in time, ideas superimposed onto the natural world by the human will.

All phenomena of the universe, macro -and microcosmic, are arguably part of systems. Earth is an ecosystem, part of the solar system and part of the galaxy. Equally we find systemic organization on the atomic level. Humans too are systems: Genetic, biological, neurological, electro-chemical and psychological systems. Non-linear and generative methodology can be used to create an increased understanding of the world and existence, not only on a personal level, but also on a transpersonal and universal level. Maybe contemporary as well as historical interest in systems-based, non-linear, fluid and “living” works of art and composition is, consciously or unconsciously, a consequence of reflections on the wider natural world in and around us? Perhaps non-linear and generative works of art can serve as an alternative scientific method to study mechanisms of micro -and macrocosmic systems, systems in ourselves and in everything around us, and as a result provide a greater understanding of the larger context. For instance, if we look at the underlying compositional principles of AVLCS /*East is Red*, and not the content nor aesthetic perspective, the balance between chaos/chance and order can be understood as a reflection on systems, a reflection on the “mechanisms of the universe”. These observations have surfaced during the thesis process as a result of contemplation on generative principles and the characteristics of non-linearity, however I'm not claiming that this thesis project fully encapsulates or gives any absolute answers to any of these open questions.

The production part of the thesis has proved to be a great learning experience with lots of “moving parts” needing to be integrated and interwoven into the system-engine structure, and where the share amount of active components has turned out to be the biggest challenge. Ironically it seems that even if the system is based on chance-based events as a method of composition, it still requires a lot of conscious thought and decision and “orderly actions to make a disorderly system”. Furthermore, it has been necessary throughout the process to strike a balance between technical concerns on one hand and aesthetic, artistic and compositional concerns on the other. This has required compromises and adaptations, but also yielded surprises which has ultimately steered the project into what is now its current form.

Turning the project into a tool for real-time performance was one of the most interesting developments during the thesis process. This development was not so radical as it may seem because the idea of using external events to create internal compositional responses was part of the original concept. However, it provided the proper form and identity to East is Red, and gave the project at large a new and interesting dimension. The expressive instrument features became interwoven into the project and I found that this addition didn't contradict or oppose the underlying compositional structure. In a way it helped in supporting the view of the composition as plastic, moldable and fluid subject matter that exists inside a predefined aesthetic area. Whenever the system is configured to be influenced by external means, performance and -or installation mode, the same underlying compositional principles apply, even though self-contained and autonomous configurations of AVLCS are meant to emphasize the non-linear and generative compositional aspects to the full extent. The work still has the same qualities when externally influenced, the same “inner life” so to speak, and exists within the same predefined area as it would in a generative and autonomous mode. The difference lies in the level of self-autonomy of the system and consists of adding an external interface which can influence audiovisual parameters and thus guide and partially control events of the composition.

To answer the question as to how such a work should be labeled and defined; as a composition, an instrument or something in between, the answer is yes, yes and yes. Indeed it's a composition: It originates from the same audiovisual infrastructure, with the same system-engine and generative engine as any autonomous work would use. The source is always the same. It's also an instrument: Parameters of the composition can be controlled in real-time by conscious actions, decisions and intent of a performer. These actions can influence a wide range of compositional features, from sequential and narrative changes on the macro level to manipulation of textures and instrument parameters on the micro-level. And finally, East is Red is something in between. It has the expressive features of an instrument and at the same time it's a creative work in itself. East is Red is a semi-generative audiovisual composition and simultaneously a *composed instrument*, balanced between the semi-autonomous mechanisms of the system-engine and external performer influence.

The development of East is Red into a composed instrument also represents a compromise: Creating a generative and non-linear compositional system in itself is not the hardest part since the most basic approaches can for instance rely on the use of pseudo random number generators. The difficult part is to create a generative system which *makes sense*, not just as a system but as a composition and work of art.



The inclusion of the human factor into the project was intentional, and a natural progression in itself, but the human influence also represents an injection of organic qualities into the compositional system which would have been a lot harder to achieve by system autonomy alone. Of course I could have gone ahead and implemented the fully autonomous configuration, but it felt like that would compromise the audiovisual material artistically. The characteristics of the actual content material has also dictated this direction to a large extent.

Understanding, defining and practically implementing the *audiovisual expression* as a form of composition has been a challenge. Obviously I have had to compose, create and design for two domains simultaneously, which somehow becomes a form of aesthetic multi-tasking. The visual and aural domains have to cooperate and reach compromises along the way, and the final result bares witness of these compromises in my opinion. A similar work without the visual part, for instance, would most likely have sounded and behaved very differently. But then again, this project has been about the audiovisual expression from the beginning. The integration between sound and image is not as coherent and tight as I would have wanted. Certain phases of the composition are indeed producing the wanted effect of the combined expression I have been looking for, whilst during other compositional phases the aural and visual domains seem to drift apart. For instance, I believe the integration of sound and visuals would have been more coherent and tight if I had based the audio-engine on internal digital sound processing (DSP) and not relying predominantly on a MIDI-based solution with external processing of sound. The chosen solution was a practical compromise which completely separated sound from video in the system environment. I think East is Red could have benefited if it had been possible to keep the original soundtracks from each of the video clips and then use the external audio-engine to build on top of that video footage sound ambience. On the other hand this project had so many active components running and certain compromises were necessary, and in a way this process has also played a part in creating a unique aesthetic identity to this work.

This project reflects my artistic interests well and I think it's able to connect my past with present work and research in a satisfactory manner. Moreover, the development of the AVLCS infrastructure plays a very important role since it essentially provides a mold which can be adapted and customized in accordance with my interests in audiovisual expressions and composition, and can therefore be used as a structure for future projects and research. The background research and the development of the contextual framework has opened many new doors, allowing me to place the concepts in accordance with historical tradition and contemporary context, as well as providing practical methods that can be implemented in my work. I have discovered that the doors opened during this thesis process have subsequently led to hallways of yet new unopened doors: This is only the beginning.

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## **APPENDIX A, B, C:**

“Lineage”, International Digital Art Exhibition & Proseminar, Shanghai 2003.

“Tipisynth”, schematic. Helsinki 2006.

“Inside a live Reptile Tent: Memento Mori”, Helsinki 2007.

## APPENDIX A

“Lineage” (2003) was an audiovisual installation based on a principle of chance and random mixing of sound and image. Three separate animations, each with separate soundtracks and of different durations, were played simultaneously but unsynchronized, creating changing visual patterns and blending of soundtracks. The three audiovisual components of Lineage represented three variables with similar but not identical characteristics. These variables would change positions according to each other over the course of time, and thus always change the visual and auditory composition of the installation. The animations were characterized by constant horizontal movement, creating flowing and fluid visuals between three monitors. Lineage consisted of three separate linear audiovisual sub-compositions; when played in unison the different parts formed a non-linear and “ever-changing” composition.



Lineage

The visual material was based on images of organic structures (roots and branches of trees) and conceptually the organic aesthetics was a direct reference to the underlying idea of the evolving fluidity and organic nature of the entire composition.

Lineage used generative principles based on a system of chance. This attempt utilized generative principles in a basic way, nevertheless it remains an important early experiment which is directly connected to the emphasis on generative methods developed for the thesis production. It represents an interesting work in the context of this thesis since the core idea is based on audiovisual chance composition. Lineage is also one of my first attempts on non-linearity using digital media, making it a conceptual predecessor to my current work and research in this field.

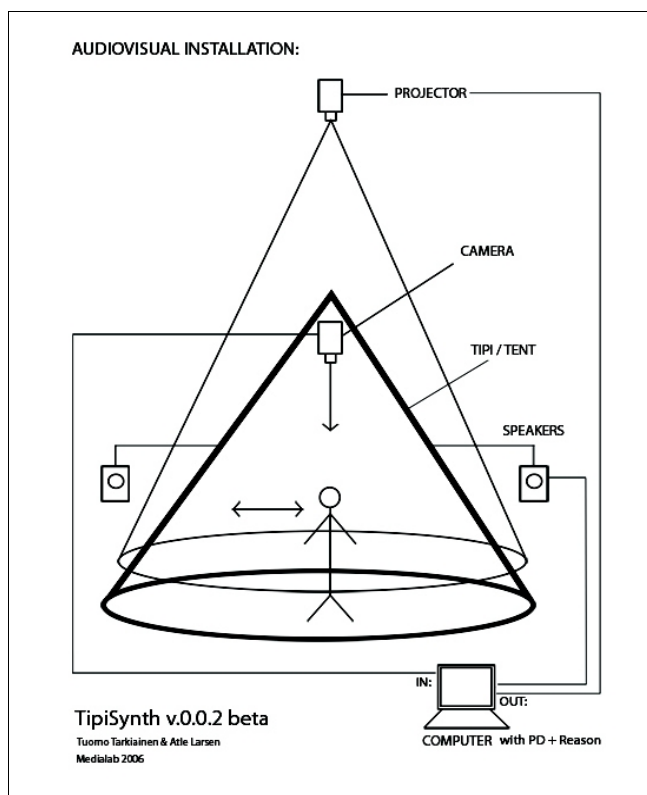
## APPENDIX B

“Tipisynth” was a working prototype of a responsive/interactive audiovisual installation, or more precisely, an audiovisual spatial instrument. Tipisynth was based on interpretation of movement data and converting this data into an audiovisual interactive experience.

A non-linear sound composition and a visual particle generator was affected by movements of audience in front of a camera by utilizing a system for movement detection. The visual concept behind this project involved projecting the particle-generated visuals onto a semi-transparent cone-shape in order to create a surrounding and immersive experience, allowing the audience to experience the piece from within the “tipi”. Tipisynth was done in collaboration with Tuomo Tarkiainen in December 2006.

This project introduced me to real-time non-linear audio composition, the effects of external influence on an internal algorithm and it was constructed in the same graphical programming environment as used for this thesis, Pure Data. My main focus in terms of sound was to create a balance, or find a compromise, between compositional concerns and audience interaction. The installation should be able to communicate its interactive properties to the audience and at the same time remain a compositional experience, not “just” an instrument. Allowing the audience to understand that the composition actually responded to their presence and actions, yet trying to remain an unpredictable and compelling composition, was a great challenge. The process itself raised some fundamental questions that later became part of the thesis research. Some of these questions dealt with defining the nature of such a work:

- a) an instrument; direct-interaction encouraging exploratory audience interaction, or
- b) a responsive composition. External data is used for driving the behaviour and generating the composition.



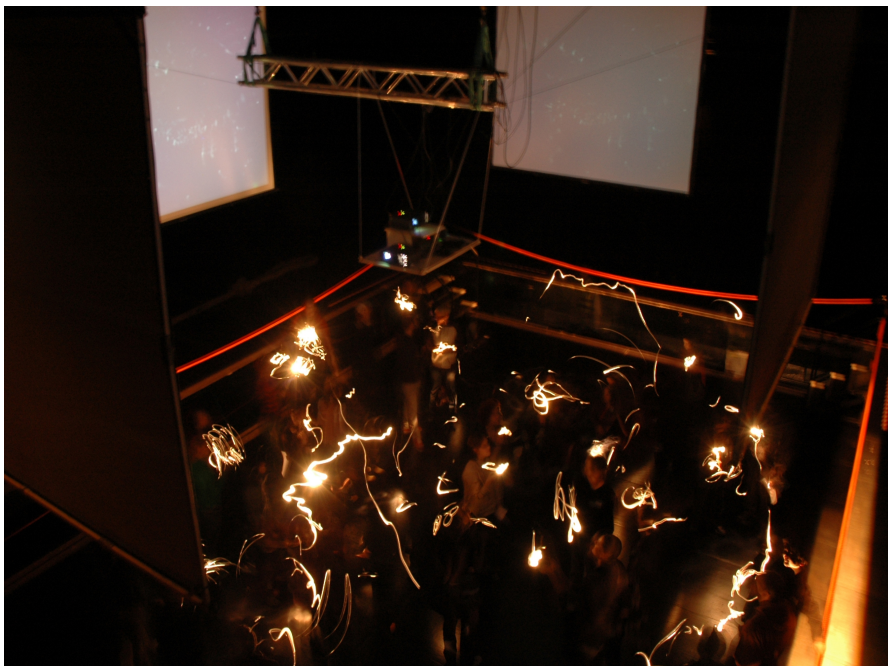
Tipisynth schematic.



## APPENDIX C

“Inside a Live Reptile Tent: Memento Mori” was a performance based on interactivity and narration. My contribution to this performance relevant to the context of this thesis was a non-linear, audiovisual, audience-responsive, surround-sound installation. The main idea behind this composition was to create an unpredictable, yet coherent composition that utilized external data for real-time control and manipulation of sounds, phrases and musical events. It used external data for triggering samples, changing of pitch and frequency as well as other (MIDI) events.

The composition was a system with an own “language”; a structure based on sound-sources and instruments that I chose with regards to artistic and aesthetic criteria, but where the actual musical events, the action, relied on being triggered by an external source. The idea was to create a responsive/interactive composition that would respond and develop by tracking movements of an audience. The system behind this composition was based on motion tracking of moving objects. Flashlights were given to each of the audience members and these lights were subsequently used to track movements, resulting in an audible surround-sound composition. This work can be considered an audiovisual work because the captured light sources were also sent through a visual effect algorithm and projected onto four screens surrounding the audience “stage”.



Responsive sound installation, Inside a live Reptile Tent: Memento Mori.